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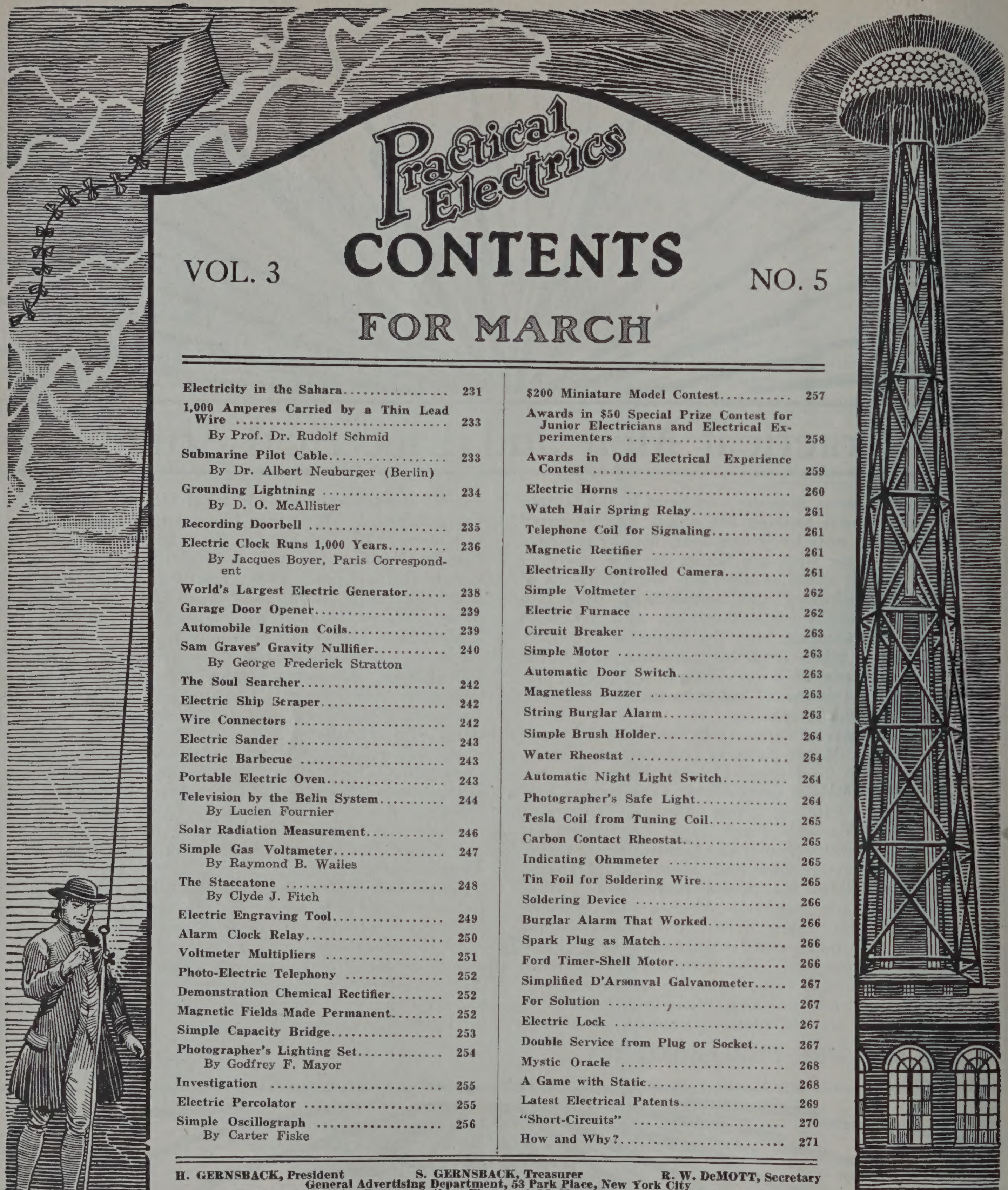

Practical Electrics

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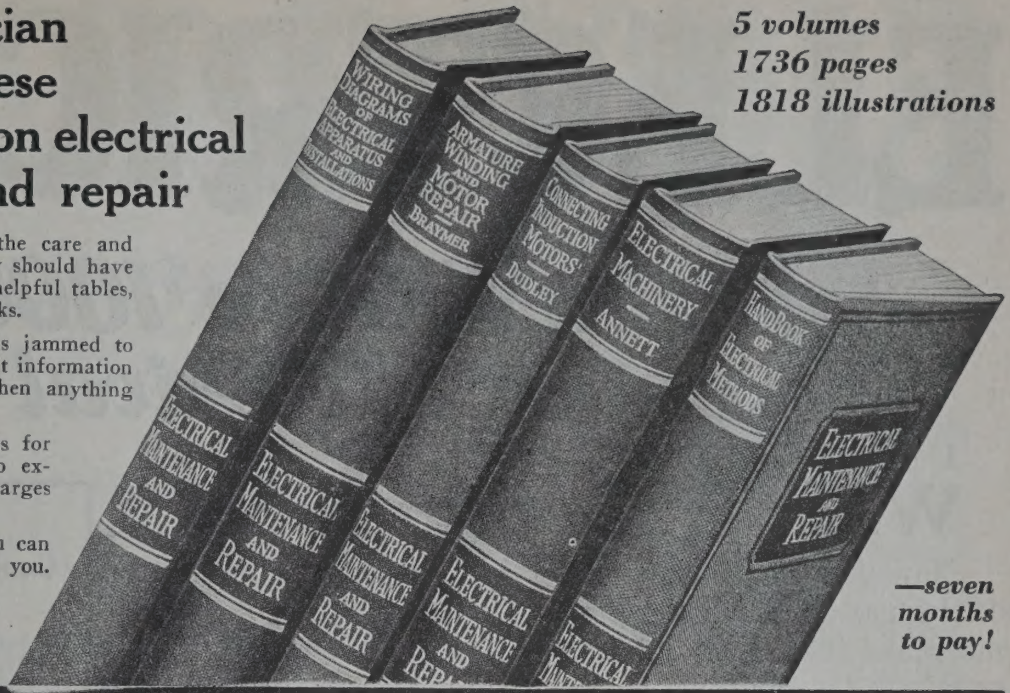
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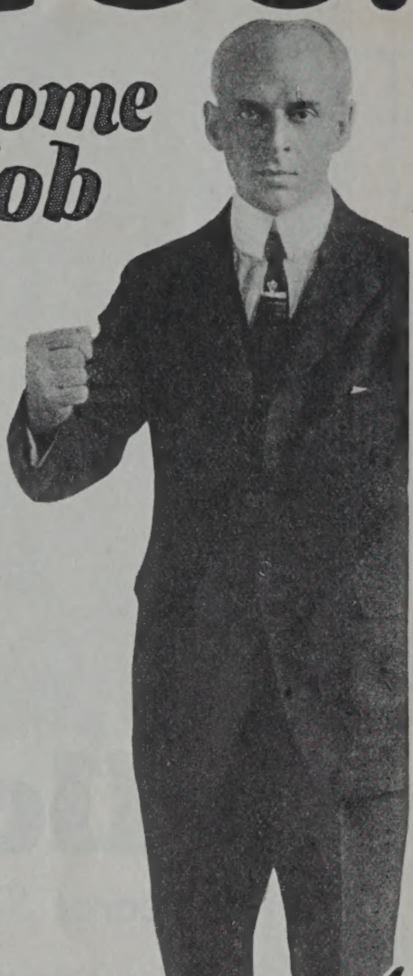

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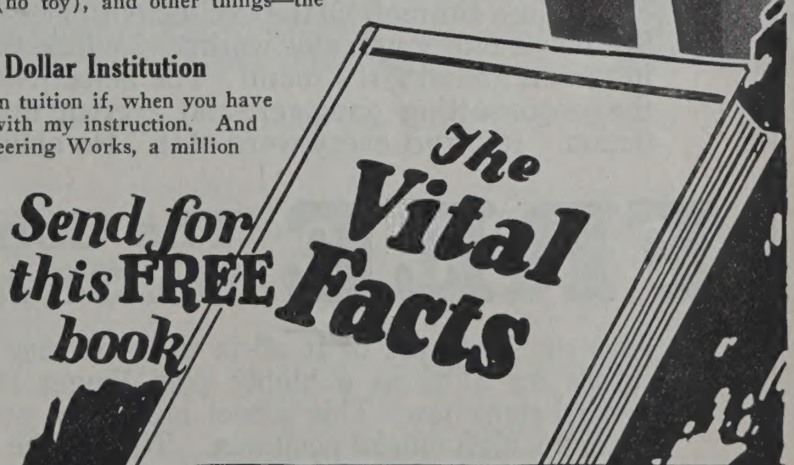
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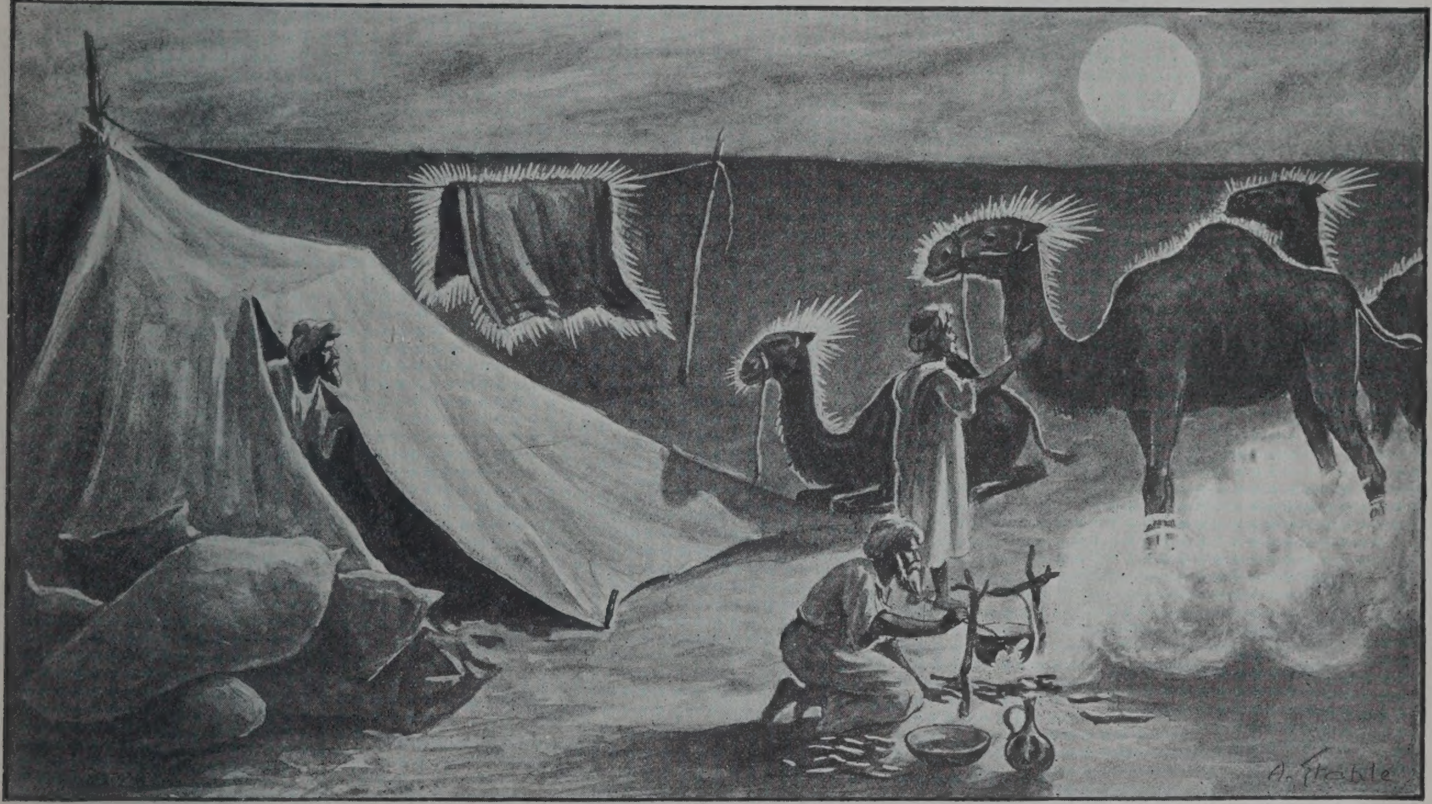
Electricity in the Sahara



Electrical phenomena in the Desert of Sahara. The inanimate blanket or burnoose made of camel's hair becomes electrically charged and produces the effect shown, while even the natural coating on the living animal becomes excited in like manner, so that the camels also show a similar discharge.

THE most inhospitable portion of the Sahara is the area known as the Libyan Desert. A route is to be organized, if possible, across this region, to connect the Nile country on the east with the western Sahara. It is picturesquely termed "The Home of the Song of the Sands."

There are a number of localities where sand seems to adhere to a certain extent, grain to grain, so that when disturbed the grains, perhaps sliding over each other or else by the mere fact of the slight adhesion being broken, produce a low sound. A good deal has been written about this phenomenon. If such sands are trodden upon a low sound is produced, which may be more or less musical. The footfall will produce such alleged singing. Once disturbed and caused to sing, the sand is no longer vocal, and it is hard to say whether it will ever recover its voice.

The writer has observed this phenomenon to some degree in the beach sand on the south side of Long Island, near this city.

Another characteristic of the desert is the wide range of temperature change during the day. At night the temperature will be but a few degrees above freezing, while in the daytime it will rise to 113 degrees Fahrenheit. This, of course, is due to the dryness of the air and absence of clouds. Without moisture the air is very diathermic and its dielectric power is very high. This leads to the development of static electricity, to the activities of brilliant electric storms, and to many other electrical phenomena. The sandstorms charging the air with grains of silica, will charge various objects with static electricity; a woolen blanket or garment which was hung out during a sandstorm will become highly charged, and when picked up, touched or shaken will discharge brilliant electrical sparks. The camels, whose thick coating of almost matted hair is essentially a blanket, become statically charged also during these storms, and flash-like discharges six and eight inches long take place from the ears. How it affects their comfort is not definitely known.

In olden days sailors would in a single voyage pass several months in the solitude of the ocean. They were quite superstitious. Strange sounds are heard at sea, probably due to distant thunder. The desert, the great sea of sand and barren rock, is also to an extent the home of mystery, and this electrical excitation is one phase of the striking manifestations to be witnessed there.

Among the unusual experiences in this issue there is a description of a luminous atmospheric electric discharge, very similar to the one depicted above, but affecting a human being.

In the case of the lighting effect in the Desert of Sahara, one is free to appeal to a certain extent at least to the idea of friction between mineral sand and animal matter, such as the camel's hair or the rug. In the case of the luminous effect produced in the instance alluded to as shown on another page, an electrical storm was blazing and the almost halo of light was one of its effects which proved quite innocuous.

Another phenomenon to those just described is often referred to as being witnessed at sea. The mast and yards of a vessel present a great quantity of points, and in electrical storms discharges of electricity are sometimes seen, almost like small flames. These form at the extremities of the yard or mast the fluid as it used to be called, always seeking pointed objects for such phenomena. The sailors apply the term "corpusant" to the apparent flame or quiet discharge thus observed, derived undoubtedly from the Latin *corpus sanctum* or "holy body," which from the theological aspect impresses one as rather a mixed metaphor.

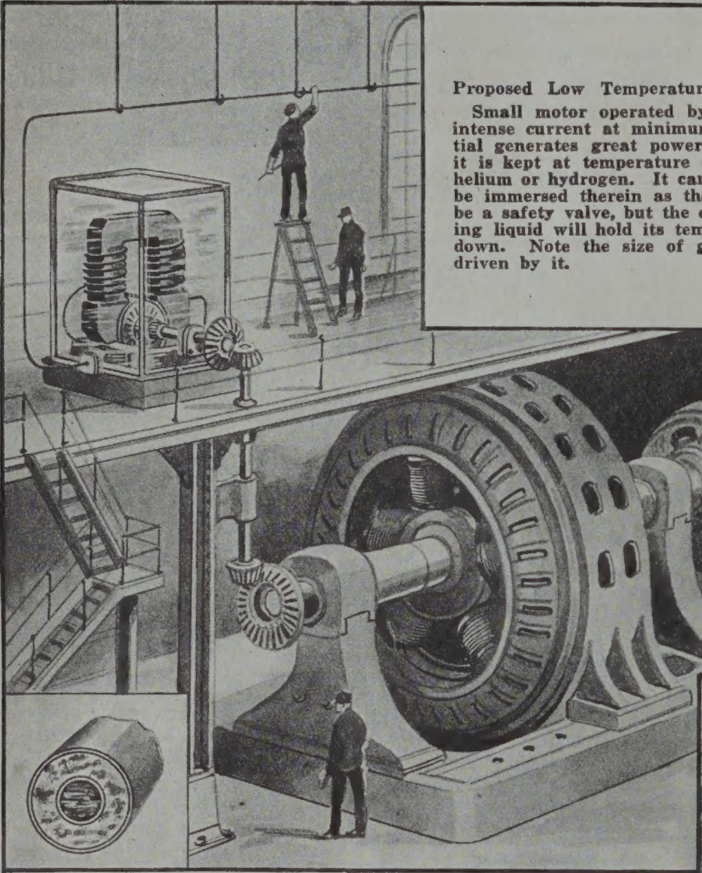
These phenomena must not be confused with the glowing of the ocean or decaying wood with phosphorescent light, as none of these are due to electrical excitation.

1,000 Amperes Carried by a Thin Lead Wire

By Prof. Dr. Rudolf Schmid

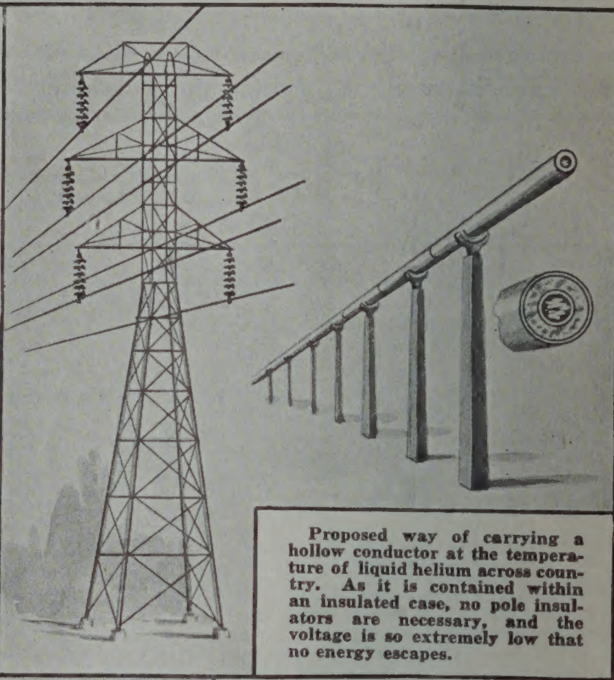
EVERY conductor of electricity opposes to the passage of this obscure natural force a resistance, which must be overcome by the electrical current. We can best picture to ourselves this resistance if we compare the electric current to a current of flowing water. Let us imagine such current of water

(*Continued on opposite page*)

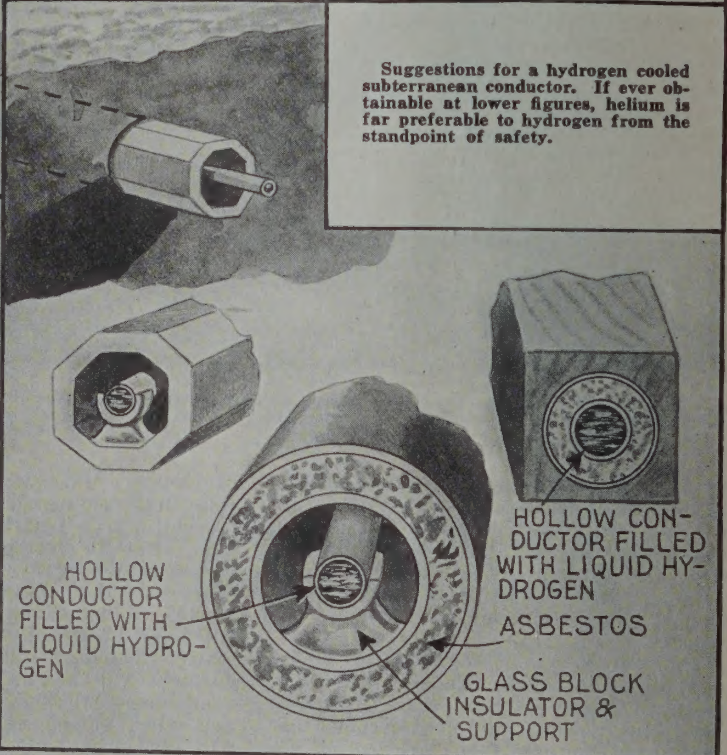


Proposed Low Temperature Motor

Small motor operated by a very intense current at minimum potential generates great power because it is kept at temperature of liquid helium or hydrogen. It cannot well be immersed therein as there must be a safety valve, but the evaporating liquid will hold its temperature down. Note the size of generator driven by it.



Proposed way of carrying a hollow conductor at the temperature of liquid helium across country. As it is contained within an insulated case, no pole insulators are necessary, and the voltage is so extremely low that no energy escapes.



Suggestions for a hydrogen cooled subterranean conductor. If ever obtainable at lower figures, helium is far preferable to hydrogen from the standpoint of safety.

HOLLOW CONDUCTOR FILLED WITH LIQUID HYDROGEN
HOLLOW CONDUCTOR FILLED WITH LIQUID HYDROGEN
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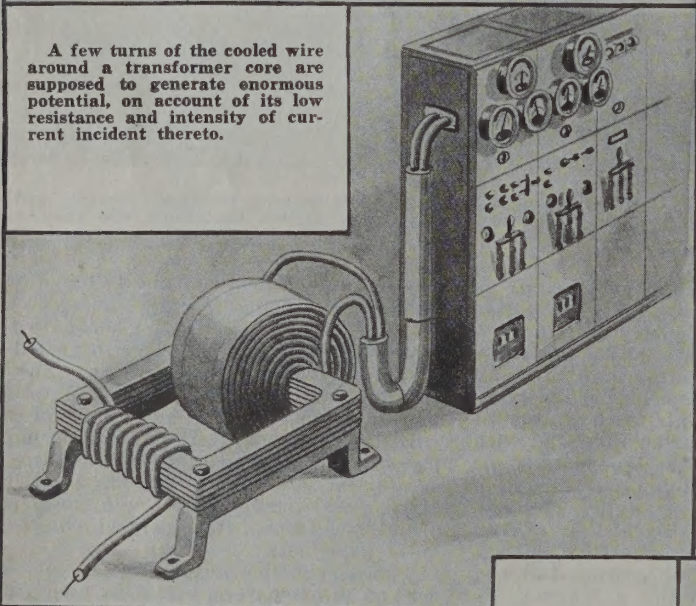
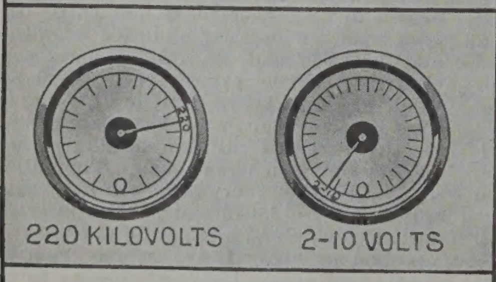
GLASS BLOCK INSULATOR & SUPPORT



A few turns of the cooled wire around a transformer core are supposed to generate enormous potential, on account of its low resistance and intensity of current incident thereto.

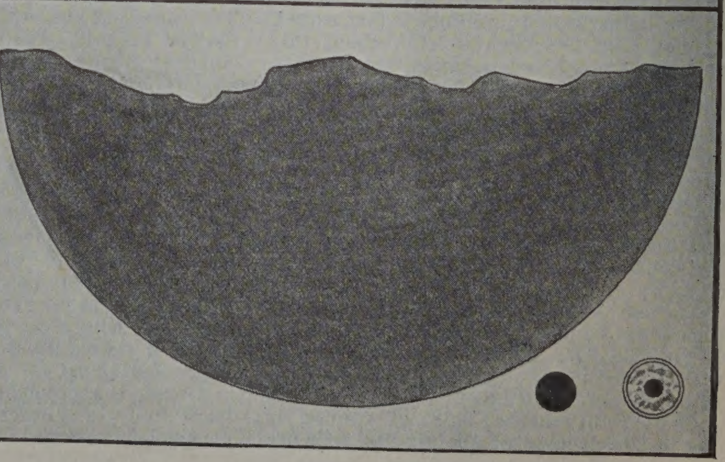


Above

Voltage required on ordinary conductors contrasted with that which would do the work on helium cooled tubes or wires.

Right

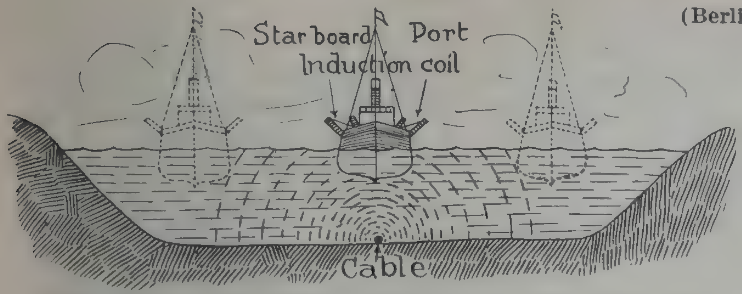
Relative sizes of conductors to carry similar currents at every-day temperatures and at the temperatures of liquid helium.



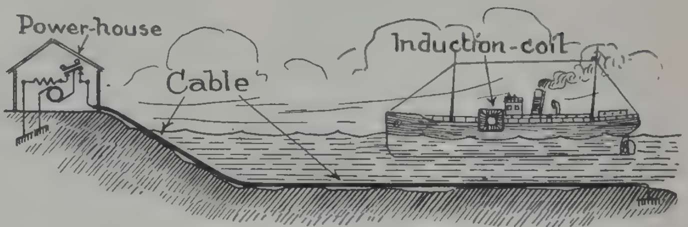
Submarine Pilot Cable

By Dr. Albert Neuburger

(Berlin)



Front view of a ship directed on her course by a cable through which an alternating current passes, affecting induction coils carried on her rail.



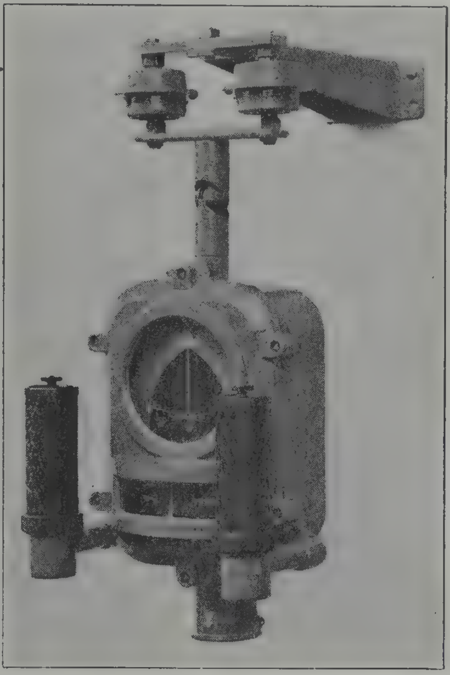
Side view of ship showing beginning of cable line for doing the piloting.

MUCH has been said about the submarine cable in the Ambrose Channel of the harbor of New York, whose function is, by the action of an alternating current passing through it, to guide ships in the center of the channel.

Coils are placed on each side of the ship so that a potential is induced in them by the current in the cable, and telephones are connected to both of them; if equal sounds are received by both telephones the ship will be directly above the cable. Any difference in the sound indicates that the ship is going to one side of the proper course.

The firm of Siemens & Halske have produced a system embodying audion tubes so as to increase the actuating current by relay action. The simple induction will be so weak that unassisted telephones would hardly be sufficiently affected by it, but with audion amplification double head phones can be successfully used. But as the action of a phone and the intensity of sound produced within it, are to a great extent a matter of judgment, a special instrument has been constructed for use on board a ship which gives visual indications. The apparatus for doing this is shown here.

Referring to the illustration, it will be seen that in the base of the case there is a rectangular window in whose center there is a perpendicular index. This is stationary. Back of the index there is a drum. This turns to right or left, according to the excitation produced in the two coils on the ship. If each coil is similarly excited, the perpendicular line on the drum shown just back of the index will be in line therewith. If to one side of the cable the drum will be turned and the line will be to one side of the fixed index. The German words for "port" and "starboard" are inscribed one to left and one to right, so that the helmsman knows exactly whether the ship is on its course or not.



Visual signal used to guide pilot so that he will keep his ship over the pilot cable in the channel.

Above the apparatus just described, there is a round window, and to right and left there are suspended needles of the galvanometer type, again actuated respectively by the current in the two coils. The position taken by the needle depends on the relative strength of current in each coil. If each coil receives an equal excitation, the needles will cross each other exactly below the perpendicular line. Any difference of excitation will cause the needles to be deviated unequally, one more than the other, so as to bring the crossing point to one side or the other of the perpendicular line which represents the proper location of the crossing of the needle. Such deviations of the crossing point shows that the ship is off her course. There is no return circuit to the cable necessarily; it is sufficient to run an insulated cable through the channel. One terminal of the generator is grounded on the shore; the other terminal connects to the cable pilot on the bottom of the channel, and the cable's outer end is stripped and perhaps connected to a plate so as to make another ground.

1,000 Amperes Carried by a Thin Lead Wire

(*Continued from preceding page*)

passing through a pipe with very rough interior. The water will only go through it with some difficulty; but if, on the other hand, the interior walls of the tube are smooth, the frictional resistance will be very slight.

No engineer who has to install a hydraulic power station would carry the water through a number of small tubes, but would try to bring the entire stream to the power station in a single conduit, so that as little as possible of the water power would be wasted in overcoming the frictional resistance of the pipes.

Just as the water current consists of millions and millions of the minutest particles of water, we must imagine the electric current to consist of milliards of the smallest divisions of matter, electrons, which rush through a conducting wire. These electrons in their passage through the wire impinge against the smallest particles of the metal and are thus retarded in their progress; these smallest divisions of metal, the so-called atoms, are not at rest, but each one moves within a definite space, a sort of orbit. The movements of this kind, performed by the atom, depend upon the temperature of the mass of the conducting matter. Thus, by increase of temperature the single atoms move more rapidly about within the confines of their movement than at lower temperatures. The electrons, therefore, will find it harder to move forward at high temperatures than at low ones, or, expressing it in another way, the resistance increases with the temperature, and naturally falls as the temperature falls. Now, it is very important for the physicist to ascertain how slight the electric resistance is at the lowest temperatures which can be produced in the laboratory today.

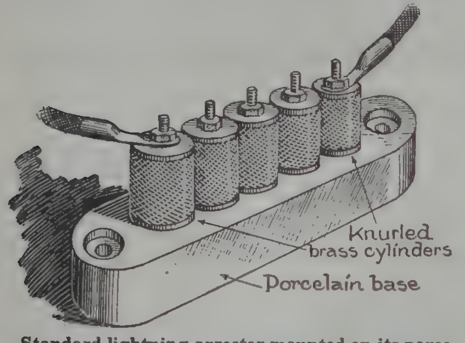
Kammerlingh Onnes, the Dutch physicist, has a cryogenic laboratory in which the temperature of minus 272 degrees C. (—457.6° F.) can be attained by successive liquefactions and quick evaporations of gases. When now Kammerlingh Onnes reduces the temperature of a wire traversed by an electric current it is found that the resistance gets smaller or the conductance becomes greater; yet the resistance can always be clearly determined. But at excessively low temperatures a very remarkable phenomenon appears: If the wire under test is cooled to the lowest temperature which can be attained today, the resistance at a definite temperature for each conductor suddenly becomes almost nil; the resistance which hitherto has been measurable becomes so small that it cannot be determined. Kammerlingh Onnes terms these temperatures the temperature "change points." If the resistance is almost zero, the electric stream can pass through the wire unopposed, the conductance is so very great. Such wires cooled to so low a temperature as to offer hardly any resistance to the electricity are called "*super-conductors.*" For example, through a super-conducting wire of lead of one millimeter diameter, a thousand amperes can be passed without heating the wire, certainly not melting it, while under ordinary conditions a few amperes will suffice to fuse it.

Why should we not take an example from Jules Verne, look into the future, and visualize the practical application of this phenomenon? If once our technique reaches the height at which the production of such temperatures costs little, the conducting wires of electric circuits will no longer be suspended in the air, but will be immersed in liquid hydrogen or helium and very thin wires in the super-conducting stage will carry thousands of amperes from the power station to the localities where they are to be used; neither transformers nor heavy cables will be needed, and much metal will be saved—certainly a very pleasant dream.—*Die Umschau.*

Grounding Lightning

By D. O. McAllister

WHEN I was a youngster, my introduction to Jove and his chariots trying to shatter all the storm clouds, was effected by being suddenly swooped down into the cellar by my mother and grandmother. But one of these electrical storms came when my father was at home. Did he rush to the cellar, with my mother, grandmother and me? He did not. And after that, no more cellar for me during any overhead fracas.



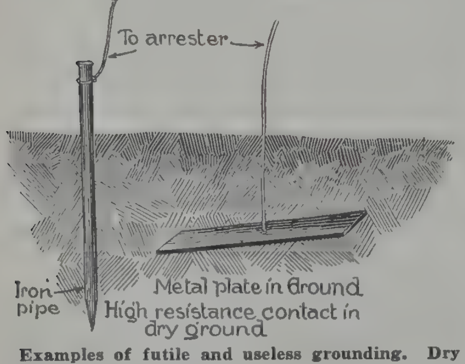
Standard lightning arrester mounted on its porcelain base, showing how a house is protected from lightning stroke when entering by telephone wire or otherwise.

This practice is entirely too prevalent; people yank their children into the cellar, and when there, all are hunched down in a cowed manner. It is likely to inculcate nervousness in one who is affrighted in this way, when the sky's artillery is booming.

It would be far more interesting, to sit or stand in the middle of some room, and observe the flashes of the lightning, for many are the queer twists and hooks it will make. It is admitted that the first time will be disconcerting, but at the second attempt or maybe the third, one will be rewarded with confidence. And if children are with you, their confidence is in you.

Then, if one wishes, the distance to the flash can be fairly estimated, by learning to count the seconds as they tick by from the instant of the flash, and the number counted too when the report of thunder is heard, is multiplied by eleven hundred; the product will be quite close to the distance in feet to where the flash occurred. And when faint-heart has been submerged by confidence in one's self, it is interesting to observe the direction of the flashes.

Many theories have gone forth as to what lightning is. But many of these would knock the preceding theory higher than a kite. And then it was noised abroad, that artificial lightning was obtained by the use of enormous dynamic voltages. But one did not discern in the noise, whether this artificial lightning could rip bark and limbs from trees, and splinter boards from buildings. So one is tempted to surmise, perhaps this man-made lightning may be as effective as a man-made rain cloud.



Examples of futile and useless grounding. Dry soil gives no ground.

My second introduction to the lightning was when I entered the employ of a public utility company. At first it was all mystery. All one had to do, was to follow the electric storm and repair damage. After fifteen years of installing and maintaining protective apparatus on the commercial circuits, and observing the protection devised for buildings, it will now be attempted to portray the protective device and its performance, and what is necessary to make it dependable.

The lightning rod is a cable wire installed over the highest points on the building, descending to the earth at each end or corners, and connected to some imbedded plate in the earth or to pipes driven in the ground. This is known as a direct path to the earth.

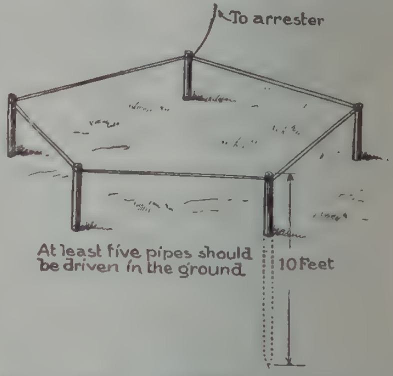
The lightning arrester is an arrangement of knurled brass cylinders, each somewhat larger than a sewing thimble. These cylinders are mounted on a porcelain or marble base. And there is about one-sixteenth of an inch between cylinders; this space is known as the gap. And the resistance across each gap is sufficient to hold in check 500 volts of normal current pressure. The voltage is the pressure, so then, if a current pressure is 2200 volts, there are five cylinders with four gaps between the current and the ground. But the gaps can be spaced wider, and less of the cylinders will be required, but whatever the number of gaps employed, they are just sufficient for the normal voltage. There is another type of arrester, which will be mentioned later.

When the lightning hits in the vicinity of a commercial circuit, it is a jolt to the generated current, and it induces high frequencies in the line. The degree of power with which the lightning hit will determine the intensity of the jolt. The enhanced frequencies break down the resistance between the gaps, and permit the excess pressure to jump across the gaps in greenish sparks. When the excess pressure has snapped its way across the arrester, and restored the normal pressure, the snapping spark will automatically cease. In other words: the action is similar to the blow-off on a steam boiler; excess pressure of steam is released, and normal pressure is retained. The time required for the arrester to discharge the lightning's blow, is in the small seconds.

On the lightning rod, the action is immediate. There are no gaps to jump; it is a straight path to the earth. And besides ensnaring a wicked flash, it serves to eliminate the ammunition of the lightning from its environs.

The first lightning arresters that were designed and installed on the circuits were looked upon with suspicion. The lightning rod's trail of chagrin was yet a fresh memory. But the pranks of the lightning made it imperative for the light companies to try again and again. And these early arresters performed so badly that one of the first designers of protective apparatus declared they were all a "Comedy of Errors."

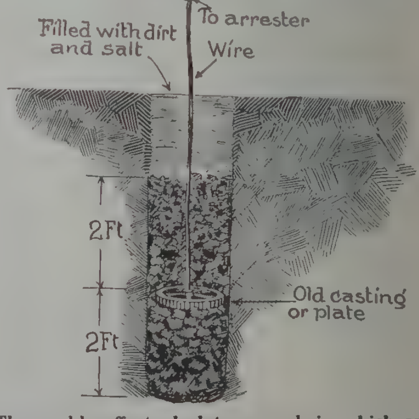
But those who were interested in this work observed that with different location of the same type of arrester, the performance varied. And why? All kinds of surmises were rendered, but they didn't mean anything. So, as a sort of last resort, environs of the grounds were looked into. And it was found that many of the grounds, the driven-in pipes and embedded plates, had just a partial contact with the earth; and too, there were found small chunks of earth baked as hard as a clinker. Now it was obvious, here was an unseen and unknown gap. For the discharging current had to jump to produce these baked particles of earth. And this imperfect ground was the cause of the original snappy spark across the arrester, suddenly turning into a huge consuming arc, which devoured many of the arresters. And this was what brought disrepute to the lightning rod, during the yester-years. Some of the grounds were found in sand, loose gravel, clay and besides foundations whence moisture would drain, and in places where moisture was minus at all times. The last two places are simply worthless for a ground; rather, they would provide a partial insulation. Then, if the lightning should strike, the installed protective device may have more resistance than the adjacent surroundings, and the results would be, that the discharge would take the path of less resistance, with more or less of the usual disastrous results.



Proper system of establishing a ground by driving in metal bars, of which any number may be used, all connected together and penetrating into damp soil.

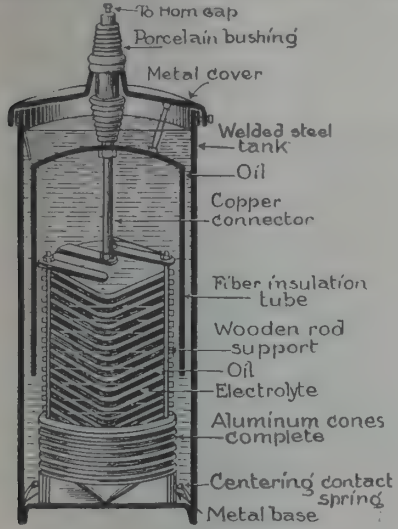
When the lightning strikes any object it is between the point where it made contact and the earth, that it does destructive work. But when it reaches the earth, all trace of it is lost. With this observation, let us see how to take advantage of the indication.

Rich and damp soils are the only safe place to install the ground. If the location is any old place, and the installing is any old way, the lightning will continue to destroy the same old way. Rich soil is more friable, and has better adhesive qualities than sand, gravel and clay; it stays put, and provides an even contact to the driven-in pipes and imbedded plate. And moisture must be present during the season of the electric storms; if not present in a natural state, it must be provided by some artificial method.



Thoroughly effectual plate ground, in which salt is used to maintain moisture about the plate so as to lower the ground resistance.

When pipe is installed for a ground, it must be galvanized and should in average cases be about ten feet in length. The end driven into the earth must have a galvanized-iron point, and a brass cap on the other end, to permit the soldering of the conductor wire to the pipe. There must be no less than five pipes driven in, and spaced in any position, with ten feet between each pipe. And as they are being driven in, sprinkle plenty of salt on the earth around the pipes, as this will aid the environments to be moist.



Electrolytic lightning arrester whose operation is described in the article. The slight film formed on the surface of the aluminum plates in a sense represents a spark gap.

But if a plate or an old casting is used, it is necessary to dig into the earth until moisture is obtained. Then at the bottom of the excavated hole, two feet of crushed coke of the size of navy beans is placed, and then the plate or old casting which has a conductor wire securely connected of not less than the size of one's little finger, is placed on the coke, and the conductor wire extends above the hole. Then two more feet of the crushed coke is placed on top of the plate or casting. And the remainder of the hole is filled with earth mixed with salt.

Now the overhead wire from the building or a commercial circuit is spliced and soldered to either one of the aforesaid grounds. And when it is ready for service, the installation as a whole, is simply the elevation of the earth up to the point where protection is desired.

In the cities the skyscrapers tower right up to meet the lightning, but these buildings have metal frame work, and foundations down below basement and sub-basement, and extensive piping; they all have a perfect contact with the earth. When lightning does hit, no one feels it. Therefore in the lesser buildings with rods and rain spouts attached to a ground which has a perfect contact with the earth, those on the inside will not feel it.

After the installation of such a ground, it would be foolishness to let it go from year to year without inspection. For as things upon the earth will decay, so will the artificial ground which is installed beneath the earth's crust deteriorate.

The ground's mission is to save property and life. If it has a perfect contact with the earth, it will provide safety for an underground chamber, and it will roll Jove's chariot wheels away from the commercial circuits.

The last decade has seen the advent of the electrolytic lightning arresters. This one was designed to meet the needs of the high-tension circuits; and this arrester nests under many strange words, but briefly it can be described in this way:

There is a metal tank, with aluminum cones, the latter resembling sponge cake baking pans, electrolyte and oil. For about each 300 volts there is one cone or cell stacked upon another; each tray is filled with electrolyte, and then placed in the tank and submerged with oil. When all is assembled, the shape compares with a kitchen hot water tank.

In normal conditions, the current forms a film of aluminum hydroxide on the cones. This film is very thin, but its resistance prevents the normal current pressure from escaping over the ground into the earth. But when a critical pressure is created by the lightning, the film breaks down in innumerable tiny punctures, and allows the excess pressure to escape to the earth. And when the normal pressure is restored, the tiny punctures seal up in an instant, and prevent the normal pressure from escaping.

But these are problems yet to be solved.

With what has been already said about the sure-fire ground, it doesn't seem like a good confession to say, that the light and power companies' equipment is still put out of commission. But one must let the facts be their guide. There is a multitude of rotating and stationary coils in the generating plant, and many of these become defective while performing their respective service. And though good eyes and ears, and searching testing instruments scrutinize each and every one of these coils, the defective place will get by.

Fulgurites or tubes of silica melted by electric discharge into dry ground. Some of these are quite large and are impressive exhibitions of lightning's power.

So all things continue to move as slick as super-oil. And then, lightning makes a hit. But the arrester, even if it does perform simultaneously with the lightning's hit, appears not to be quick enough to save the defective place in the generating plant. Yet one must remember, the generator's own current will also find the defective place in time.

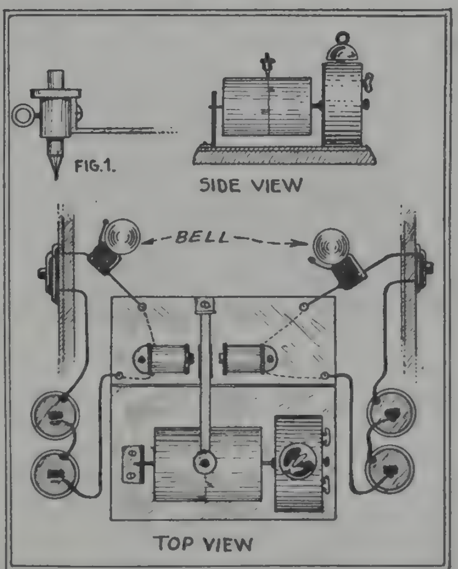
But on the lightning rod, the eye can catch all defective places; nor does the rod have coils for the lightning to multiply the induction of the current.

To further impress the importance of the contact with the earth, it is desired to borrow a phrase from a biblical writer, "And now abideth . . ." lightning, arrester, ground, "these three; but the greatest of these is" the ground.

Recording Doorbell

THE doorbell herewith described may be used to record the hour of any call, and will prove quite useful, when anyone rings the bell and no one is at home to answer the door. The one instrument may be connected to both the front and back doors and thus will indicate which bell was rung.

The instruments may be placed on a wooden base as shown and slipped into a small box or cabinet so as to be out of the way and for protection from dust, etc. The first part to make is the rotating cylinder; this may be made of wood with a hole drilled through its center for the shaft. A metal support holds one end of the shaft while the other is fastened to an alarm clock, which is used to rotate the cylinder. This being completed, another wooden base is placed to one side as shown, so that it will be almost as high as the top of the wooden cylinder. On this base is mounted the soft iron armature. One end of this is journalled by a pivot but not too loosely, and the other end has a spool attached for holding a pencil which will later rest on the paper covering the wooden cylinder, making a mark as the cylinder rotates. On each side of the armature are located two small electro-magnets, these being connected in series with the bells, push-buttons, and batteries.



Interesting apparatus for recording on a sheet of paper on a rotating drum the hour and minute when a caller presses the bell button of a door.

The instrument is now complete and ready for operation. A piece of paper is fastened around the cylinder and the clock is wound so that the cylinder will rotate in accordance with either hand of the clock. The instrument needs no other attention except winding and placing a clean sheet of paper on the cylinder. When the doorbell is rung the corresponding magnet pulls the armature to it, and thus changes the course of the pencil mark on the cylinder. When wishing to know when the bell was rung, all that is necessary is to note the pencil mark on the paper. The time at which the mark was made may be determined by noting its relation to the clock.

The illustration shows an instrument for use with two doorbells, but an apparatus may be easily constructed for only one if desired. One magnet pulls the armature one way, the other draws it in the reverse direction, so that the marks on the paper tell which bell was rung.

Contributed by Evermont Fisel.

German Underground Telegraph System

By Dr. Albert Neuburger

(Berlin)

GERMANY is on the point of reorganizing her telephonic service. Like America, that country has suffered annually from violent snowstorms which sometimes block the traffic for weeks together. Nearly every winter Berlin is cut off for a long time from the outside world in numerous directions, communication with Amsterdam, Paris, Prague, Vienna, Budapest and other places being destroyed by blizzards.

The German State Postal Administration regularly employs no fewer than 30,000 operatives, whose exclusive business it is to repair the wires which have been destroyed through storms and other causes. The work is frequently doubled and trebled in the winter. The snowstorms in central Germany are so violent, that the wires are often beaten down or thrown on their side. Even a quiet fall of snow may wreck the wires, if the snow is wet and very heavy. In this case it sticks together and masses itself in high layers upon the wires. The wires are finally unable to bear the weight of the accumulation resting on them; the snow stretches and drags down the wires until even the poles are torn down and the wreck is complete. Severe cold operates in a similar manner through the shrinking of the wires; this also affects the masts, which, especially when many wires are carried, are overturned in spite of all means of support attached to them.

In order to save the great and frequently recurring expense of repairing and replacing the wires, Germany is to place all lines underground.

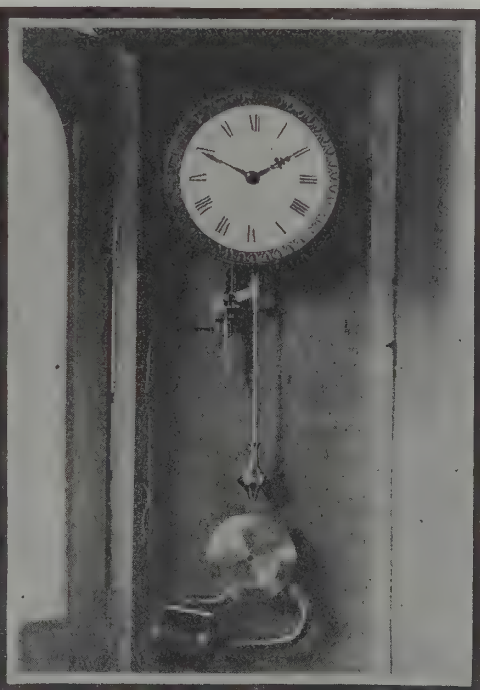
Example of destruction wrought upon aerial telegraph lines by snow and ice in Germany, showing that America has no monopoly of this trouble.

Electric Clock Runs 1,000 Years

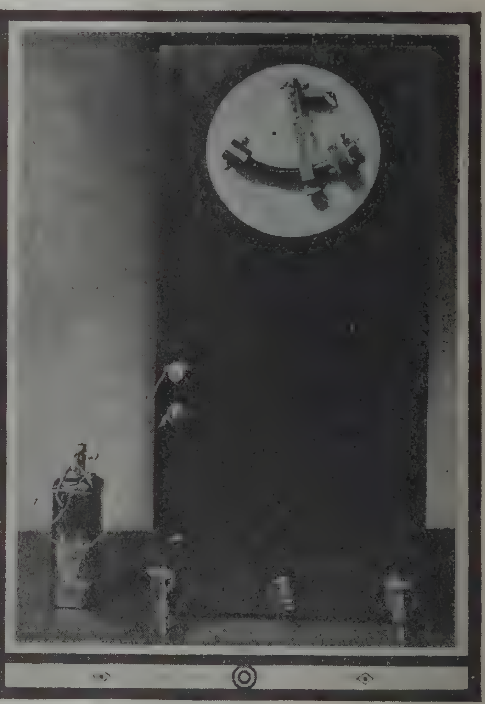
By Jacques Boyer

Paris Correspondent

Fery electric clock by the eminent inventor of the Fery battery.



In this clock is shown the horseshoe magnet used to maintain motion of pendulum.



Synchronizing apparatus of household clock to be operated from master clock in some central station.

THERE is no doubt that electricity will accomplish the winding of our watches and clocks, now that technicians have surmounted the obstacles which formerly stood in the way of the progress of electrical horology.

There is no doubt that electric time pieces will show an incontestable superiority over mechanical ones, but many are the more or less ingenious methods which have been proposed in the last 75 years, to solve the difficult electro-chronometric problems.

In 1840, Bain was the first to construct a clock operated by electro-magnetic action, and he was followed by numerous inventors. Among them Lilias, Verité, Froment, Paul Garnier, invented various systems of electric clocks which can be reduced to few types. When the motor of the time-piece, spring or weight reached the end of its course, a contact closed the circuit of an electro-magnet or of an electric motor which wound the clock. But all these were merely laboratory curiosities and not practical apparatus at a commercial price.

Electro-horology will follow a fertile course, when the electric current has nothing to do but keep up the oscillations of the pendulum. Intermediate gearing between the source of energy moving the hands, and the escapement mechanism regulating the time, then will be suppressed. But if we want to devise a motor of really good applicability, it will be at once evident that we must give up the electro-magnet for producing these oscillatory impulses. All clocks utilizing such process expend far too much electrical energy. Besides, the opening of the circuit produces a spark which rapidly deteriorates the contact points.

Innumerable attempts were made to remedy these troubles, which attempts were very seductive from the point of view of time-keeping; but their complication always reduced the electric practicability. Foucault in 1860, invented a very ingenious contact, which was introduced into commerce by the Swiss clock makers Hipp, and this reduced the influence of the irregularity of the impulses. In this electro-magnetic escapement the acceleration of the movement took place when the pendulum was approaching the end of its swing. The electric contact was made from time to time whenever the amplitude of the oscillation fell below a certain length. In spite of its ingenuity, the Hipp pendulum was abandoned, because the spark at the break was so strong that it interfered with the working, and its primary battery was exhausted far too quickly.

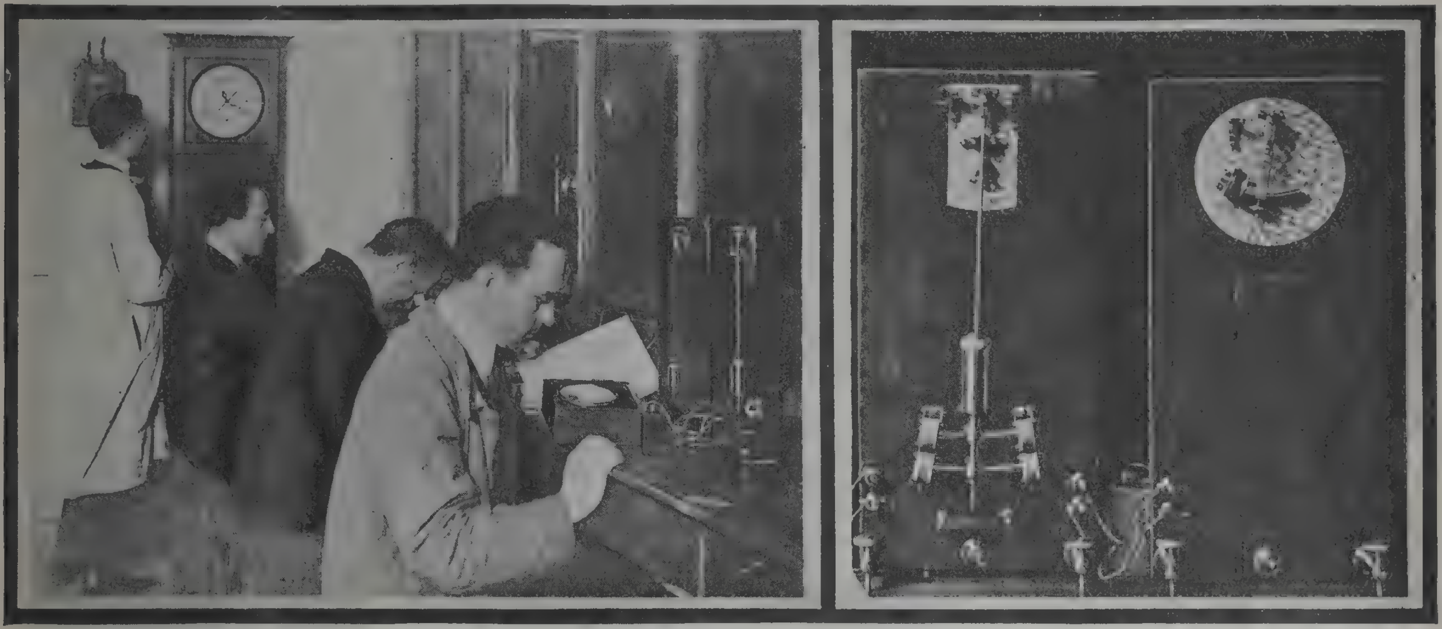
In 1901 the French physicist Charles Fery had the idea of combining a magnet and a coil mutually subject to displacement, one from the other. This combination develops a counter-electromotive force, opposed to the polarity of the battery, and utilizes in a rational way the energy of the electric source in accordance with theory, and again from the point of view of time-keeping gives excellent results. The Fery clock contains a horseshoe magnet, Figure 1, displacing itself from the neighborhood of a coil interpolated in an electric circuit containing a constant voltage battery and a circuit breaker. The pendulum, Figure 1, moves the lever of the circuit breaker automatically, so as to close the circuit for a very short time, as the pendulum is passing close to the vertical. As the connections are arranged the pendulum receives at this instant an accelerating impulse, maintaining a constant oscillation.

On the other hand it also operates the mechanism of the hands of the clock by means of a pawl, which pushes a ratchet wheel around, one tooth for each swing. Intermediate gearing connects the minute hand to this ratchet gear. The various gear wheels which turn freely, without the friction incident to being subjected to the action of a spring or weight as in the ordinary clock, absorb very little energy. The battery gives the mechanical impulses without any intermediary to cause mechanical loss.

This invention carries out perfectly the theoretical conditions which are requisite for keeping up the movements of the pendulum without perturbation as specified by Lippman in 1898. He said that it was necessary to restore its energy to the pendulum only as it passed through the vertical, otherwise the isochronism of its oscillations would be destroyed. Thus it seems that for a long time electric horology has dictated the principles on which the Fery system is based, which principles have been followed by all his successors with greater or less modifications. In the Bardon clock for instance, the magnet is parallel to the plane of oscillations, the cores not entering the interior of the fixed coil; in that of Moulin Pavre-Bulle called the Bulle clock, the core is fixed and the coil moves. In the Vaucauson clock the same arrangement is found combined with a Foucault-Hipp regulator. Fery has recently introduced an interesting improvement in these electric clocks. He places the 'scape wheel in the circuit, which reduces the number of contacts produced each day by each tooth.

Finally, at the last congress of chronometry which convened in the Paris Observatory from the 12th to the 27th of October, 1923, Marius Lavet exhibited some very interesting clocks which theoretically could go for a thousand years and whose manufacture was taken up by the Hatot establishment with the idea of reducing their cost. In his remarkable memoir the learned specialist drew attention to the interest which the application of electric operation presented from the standpoint of everyday use. His demonstration apparatus recently made practical, are based on the same general principle as the Fery clock but differ therefrom by the numerous details of construction whose aim is to reduce the expenditure of electricity to an extremely small amount, and thus to avoid deterioration of the contacts and expenditure of battery.

For chronometric instruments which have to operate at a greatly reduced amplitude and which are capable of measuring time with great exactness, he arms the pendulum with several quite short electro-magnets, one below the other, and keeps them placed close together, as shown. of which the opposed poles face each other. The ends of these magnets enter into small coils of wire divided into two groups successively receiving current each time the pendulum passes the vertical, moving either to right or left. On account of the connections the magnetic flux due to the current ensures the polarity of the permanent magnets and makes it possible to increase the electric output at will. The Hatot Company (according to our contemporary *La France Horlogère*) have also studied out with the assistance of M. Lavet very small balance wheels capable of realizing simple strong movements and a very slight friction for domestic clocks. An electro-magnetic arrangement is used for this purpose, including two oppositely wound coils; there is no need in this case of definitely fixing the points of the course of the clock when the circuits shall be made and broken. A greatly simplified circuit breaker can be used, operating very near the axis of rotation.

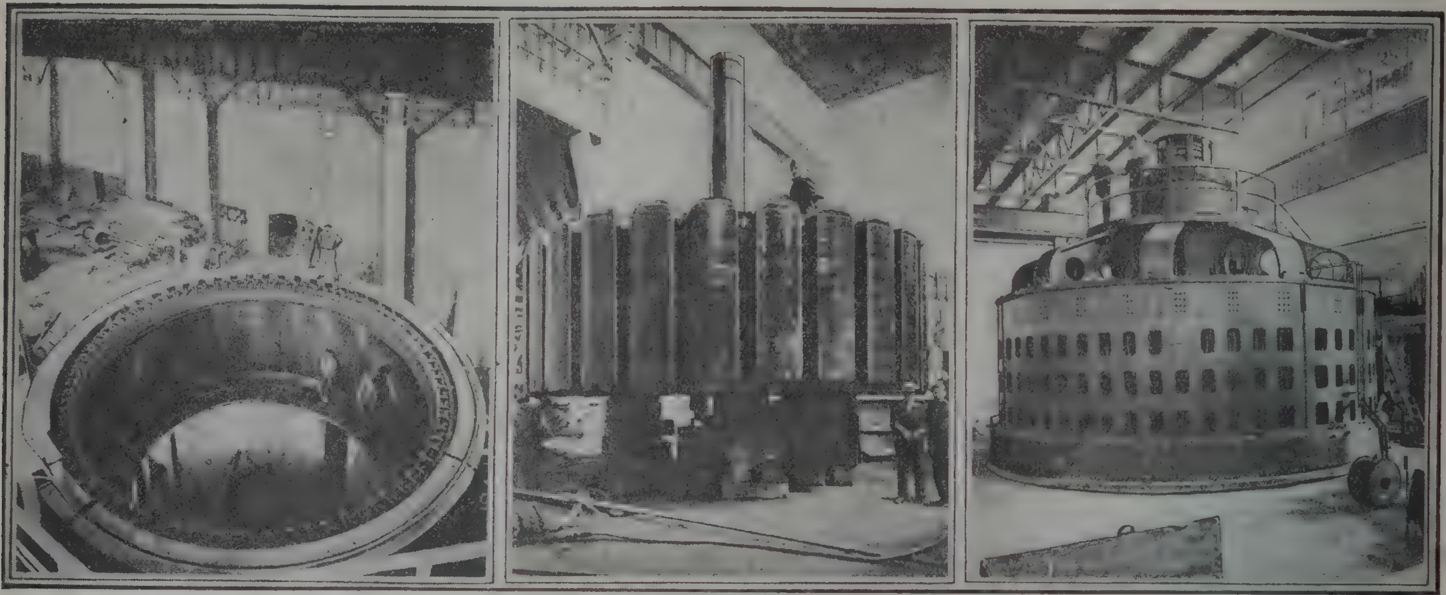


Left. Operator regulating duration of electric impulses for operating distant clocks from a master time piece.
Right. Electric clock which will go for one thousand years, operating another clock, shown to the right.

The Lavet electric clocks can be used for distributing time by the ordinary synchronic methods, systems which require quite a consumption of electric energy. In order to diminish this expenditure, the technician places in the various clocks an interrupter to limit the expenditure of current to the minimum necessary for maintaining the movement. The impulses are produced at the instant when the velocity of the oscillating organ, the pendulum, is at its maximum, which favors a high efficiency; besides this the opening of the circuit is ensured by individual action of each of the distant clocks and not by the contact of the master clock alone. The operator regulates the duration of the impulses of current according to the requirements for maintaining the oscillatory amplitude constantly.

Finally, we must state that a dry cell can furnish 100-watt hours, which, according to theoretical calculations, is enough for a Lavet-Hatot clock for ten centuries. But, of course, the battery would deteriorate much more rapidly on account of evaporation of the liquid, and wasteful chemical reactions are produced even on open circuit. But now the new Fery battery with air depolarization is exhausted only in proportion to the electric energy taken from it, and makes it possible to drive a clock movement almost indefinitely without interruption. The inventor only names this 1000 years to indicate the slight amount of electric energy required to run the clock for a very long period of time.

World's Largest Electric Generator



Three views of the largest dynamo in the world. On the left is seen interior of stator; then comes the giant rotor, and the entire machine set up ready to work is shown on the right.

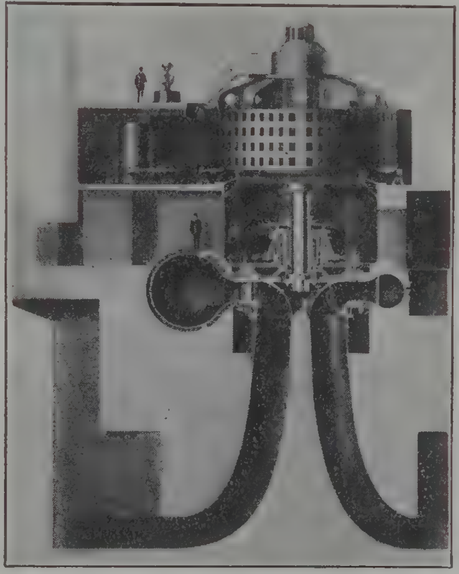
BEFORE a delegation of prominent electric power men and Government officials, the world's largest hydro-electric unit was placed in commercial operation at Niagara Falls, Tuesday, December 18, 1923, in the new power plant of the Niagara Falls Power Company on the American side of the Niagara River.

This giant unit weighs more than 1,750 tons. It consists of a 70,000-horsepower, single runner, vertical shaft hydraulic turbine attached to an electric generator delivering 65,000 k.v.a. at 12,000 volts. This is the first of two such units being installed in the new $12,000,000 project of the Niagara Falls Power Company.

When completed this station will house units with a total rated capacity of 454,000 horsepower. The company has two other stations with rated capacities of more than 200,000 horsepower. The annual output of the American Niagara system is in excess of two billion, five hundred million kilowatt-hours and represents about one-third of the electricity sold in New York State.

This new 70,000-horsepower hydro-electric unit uses 3,500 cubic feet of water per second with an efficiency of at least 93 per cent. It does not increase the company's diversion of water in any way but does materially increase the efficiency of conversion into power. It uses the same amount of water formerly consumed by seven 5,000-horsepower units and delivers energy equivalent to the output of fourteen such units. Each of the three new 70,000-horsepower units will produce electricity, which, if generated through the use of coal, would require 700,000 tons annually. The new project will not use any more water than is now used but will so use the water as to produce an increase of 100,000 horsepower of electricity.

The turbine of this unit is the highest power capacity waterwheel ever built. It is a product of the I. P. Morris division of the William Cramp & Sons Ship and Engine Building Company of Philadelphia. Specially designed cars were required to transport the great castings assembled into this turbine. The runner is a single-piece steel casting weighing 105,000 pounds. The turbine casing and control valve required 32 car loads of parts. The turbine converts the power of the falling water into mechanical energy, which is directly transmitted by means of the 32-inch shaft to the generator immediately above.



Combination of suspended dynamo and actuating turbine representing a load for a small ship.

The generator sets a new high mark in design and construction of electrical equipment. The stator weighs 228 tons. The rotor, occupying the interior of the stator, with its twenty-eight, 8-ton poles, measures 21 feet in diameter and weighs 399 tons. The revolving elements, consisting of rotor, shaft, and water wheel runner, total approximately 500 tons and are suspended from the top of the unit by a Kingsbury thrust bearing. The generator was manufactured at the Schenectady works of the General Electric Company, where a companion machine is now approaching completion.

The new hydro-electric units will receive their supply of water through a new hydraulic pressure tunnel. This tube, measuring 32 feet in diameter and 4,300 feet in length, carries the water from the head of the rapids above the falls under the city of Niagara Falls to the edge of the high cliff below the falls. The tunnel discharges into a great forebay or basin from which the water is conducted to the turbines by means of three 21-foot slope tunnel penstocks cut through the limestone cliff.

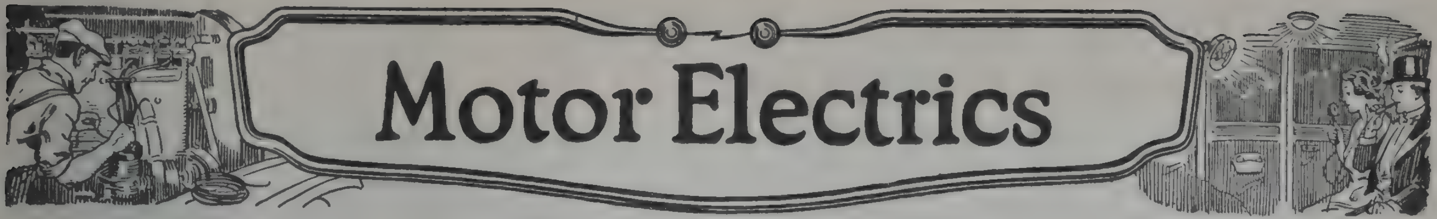
This increased production will immediately benefit the entire territory now served with Niagara power. The transmission lines radiating from Niagara Falls serve a vast community stretching from Erie and Jamestown on the west to Syracuse and Oswego on the east. The flow of these rivers of electricity will be substantially increased. Each of the 147 communities in the sixteen counties now served will have improved service. Some two million people will share in the increased power produced by this project.

Testing Metals with a Microphone

STRETCHING a metal until it squeaks and listening for the squeak with a microphone will give a test showing how much strain that metal can stand as a girder in a bridge or as a rail in a railroad track, according to experiments conducted in the physics department of Lehigh University. The investigators expect that these experiments will develop a novel method of finding quickly and accurately the elastic limit of metals. By this method all forgings may be rapidly tested before they are put into use on construction work.

Several kinds of metals have been used in the Lehigh tests. While professors listened through a sensitive microphone similar to the dictaphone for the faintest sound, the metal was subjected to a gradually increasing pull until broken. It was found that squeaking, rasping sounds were produced after the pull had reached a certain definite value, and this value was different for the different metals used. The tests indicated that the sounds were not produced until the elastic limit of the material had been reached. The work will be continued with more refined apparatus in the Lehigh physics laboratory, so that more accurate tests and data concerning the strains that different metals may withstand can be obtained for practical use.—*American Machinist.*

Motor Electrics



Garage Door Opener

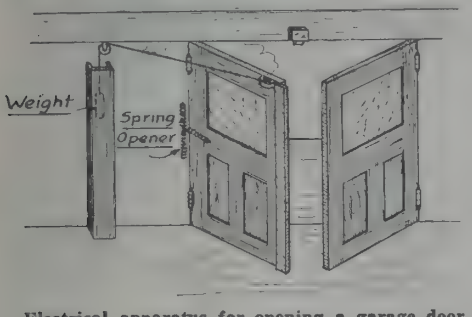
IT is always very annoying to get out of the auto and open the garage doors when driving into the garage, especially during inclement weather. Therefore, I have designed the electrical door opener here described.

The doors should be hung on a good hinge that works freely and they will work better if they swing inward; but they may be swung outward providing that the snow and ice is kept cleared away in the winter time.

Spring door openers similar to the ones used on fire department doors are moderate in price. They may be purchased in a size suitable for any kind and weight of door. If you care to make your own opener you may use weights fastened to the doors with sash cord run through pulleys. The weights should be boxed in so as to insure free space for them always. Otherwise, through carelessness, you may put something in the way that would interfere with their working freely.

Be sure first that your doors work easily and that your weight is not too heavy or it will open your doors with a bang. A bumper of some sort, either a piece of rubber or a spring, may be installed to receive the shock of the door. Next, either buy or make an electric magnet of the type now in use in many of the apartment houses to unlock a hall door from a distant point. The majority of these magnets operate on dry cells and are quite satisfactory.

Mount this magnet over one door so that it will hold the doors when closed against the pull of the weight. Then run a line to a push button on the inside of the garage and one to the outside to a point on a post or wall that can be reached from the driver's seat when the car approaches the garage. This switch may be a push button but a lock switch of some sort is preferable. This can be bought, but the ignition switch from an old auto will be very satisfactory. Place a shield over this switch to protect it from the weather.



Electrical apparatus for opening a garage door from the driver's seat in the car, so that there is no need of leaving the car.

This arrangement will be found to be very convenient as the doors are closed and locked while you are away and when you return it is only necessary to drive up to the switch, stop and insert the key, unlock doors and drive in without getting out of the car.

Keep pulleys, hinges and magnet socket oiled well with rather heavy oil as this adds greatly to the free operation of the doors.

Contributed by Archibald Amos.

Automobile Ignition Coils

By Harold Jackson

BEFORE the low tension current supplied by the storage battery or magneto can be used for the ignition of internal-combustion engines, such as automobile motors, it must be raised to a potential or voltage of several thousand volts, so that it will jump the air gap between the electrodes of the spark plug.

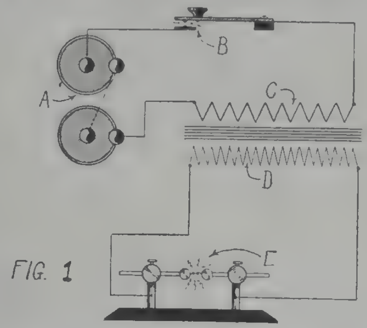


FIG. 1

Operation of an automobile ignition coil simplified for purpose of giving the theory of its action.

> *EXPERIMENTERS and amateurs, we want your ideas. Tell us about that new electrical stunt you have meant to write up right along, but never got to. Perhaps you have a new idea, perhaps you have seen some new electrically arranged "do-funny"—we want these ideas, all of them. For all such contributed articles that are accepted we will pay one cent a word upon publication. The shorter the article, and the better the illustration—whether it is a sketch or photograph—the better we like it. Why not get busy at once? Write legibly, in ink, and on one side of the paper only.* EDITOR.

This rise of pressure is effected by the use of induction coils. There are two types of coils in common use, the vibrating coil and the non-vibrating coil. The vibrating coil is little used; this type of coil appears only on one or two makes of American automobiles, the great majority employing the non-vibrating type; therefore the non-vibrating type only will be considered in this article.

The non-vibrating coil consists essentially of three parts. the core, the primary winding, and the secondary winding. The core usually consists of a bundle of thin soft iron wires, gathered into a cylinder one-half to three-quarters of an inch in diameter. This core is insulated and wound with a few layers of No. 14 B. & S. gauge insulated copper wire. This forms the primary winding which carries the low-tension or battery current. The secondary winding is then wound over the primary, there being absolutely no electrical connection between them. The secondary winding consists of hundreds or even thousands of turns of very fine hair-like insulated copper wire, about No. 36 B. & S. gauge.

The proportion between the primary voltage and the secondary voltage is the same as the proportion between the turns of the primary winding and of the secondary winding; that is, if the secondary winding consists of ten times as many turns as the primary winding, the secondary voltage will be approximately ten times the primary voltage. If the primary of an induction coil whose ratio is 10 to 1 is supplied with ten volts, a pressure of one hundred volts will be induced in the secondary winding. A ratio of 10 to 1 is far too low for practical purposes, this being used for an example only.

Figure 1 shows how a spark is produced with a non-vibrating coil. Such coil consists of two independent circuits, the primary which consists of the primary winding (C), battery (A) and key (B), and the secondary, which consists of the secondary winding (D) and the spark gap (E), with no electrical connection between the two. The primary circuit is closed by depressing the key (B). This causes the battery current to flow through the primary winding of the coil. When the primary current is quickly broken by releasing the pressure on the key, a powerful pressure is induced in the secondary winding, which causes a spark to jump between the electrodes of the spark gap (E). This spark occurs only upon the rupture of the primary circuit and not when this circuit is closed.

In order to make use of a coil of this type for ignition the equipment shown in Figure 2 is necessary. The parts in this diagram correspond with those of Figure 1, except that a switch is placed in the primary circuit so that it may be controlled; likewise a switch, or distributor, is placed in the secondary circuit by which the high-tension current is controlled. The parts in Figure 2 are: (A) storage battery, (B) circuit breaker, (C) primary winding, (D) secondary winding, (E) spark plugs, (F) distributor, (G) switch.

With the ignition switch (G) closed, the turning of the motor causes the primary circuit to be broken at certain intervals by the action of the cam against which the circuit breaker arm bears.

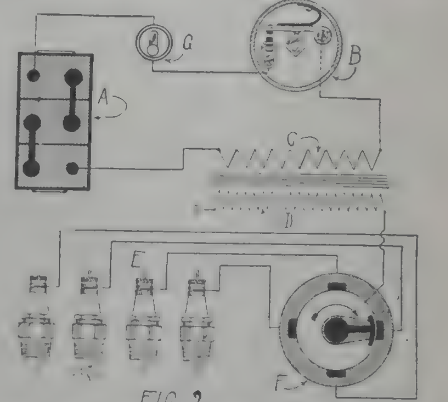


FIG. 2

Full connection of automobile ignition system; the circuit-breaker is shown; the secondary of the coil is grounded.

The breaking of the primary circuit causes high pressure impulses in the secondary circuit. These are distributed to the spark plugs by means of the distributor (F), in the proper order which corresponds with the firing order of the motor.

To prevent sparks forming at the contact points of the circuit breaker, when the primary circuit is broken, a condenser is connected across these points.

Sam Graves' Gravity Nullifier

By George Frederic Stratton

GEORGE M. LUNDHOLM, the imperious President of the Uinta Power and Light Company, glared at the photograph, the wrinkles in his square, strong forehead drawn together in a cynical frown of doubt.

"Is this the—er—thing?" he demanded of Hidreth, his Chief Construction Engineer, who had just handed him the picture.

"Well, no! But it's one of the countless proofs of the power of the 'Thing.' You remember the Genie of fairy book fame who had no power until liberated from the bottle. Well, this fellow performs his stunts while still imprisoned in a two by four box. Houdini's arts are not wanted. The contraption you are looking at is in the mouth of the Ophongo Canyon, which opens out of the foothills where Graves' house is. It's a blind canyon; no trail up and no water. On one side, as you see, there's an almost perpendicular cliff, and twelve hundred feet up that cliff there's an acre or two of flat bench.

"Off that ledge Graves has projected two steel beams to carry those upper wheels. These are grooved wheels, eight feet in diameter, keyed to the ends of an eight-foot shaft, and each carries an endless steel cable from similar wheels twelve hundred feet below. And, fastened between those cables are barrels—ordinary whiskey barrels, I guess—so that as one line is coming down the other is going up.

"And that line of barrels going up, Mr. Lundholm, has its gravity entirely nullified until each barrel passes over the top wheel; then it regains its normal weight, which is all used for the downward pull."

"H-mp! Then, as I understand it, Hidreth, this fellow claims that the ascending line of barrels has no weight, while the descending line has—well—how much?"

"There are no less than three hundred barrels on each side, Mr. Lundholm. They're filled with wet sand and the total weight on the descending line cannot be much less than two hundred thousand pounds! The shaft at the foot of the cliff carries, as you see, a three-ton flywheel on one end and a driving pulley on the other."

"What's he driving with it?" asked the President.

"Nothing. He says that he built the outfit simply as a model for demonstration; that he could belt it to generators or sawmills or anything and give three or four thousand horsepower! Some little model, eh, Mr. Lundholm?"

The President made no response to that. The muscles of his wrists were rigid as bronze as he grasped the arms of his chair and in a voice astringent with irony he asked:

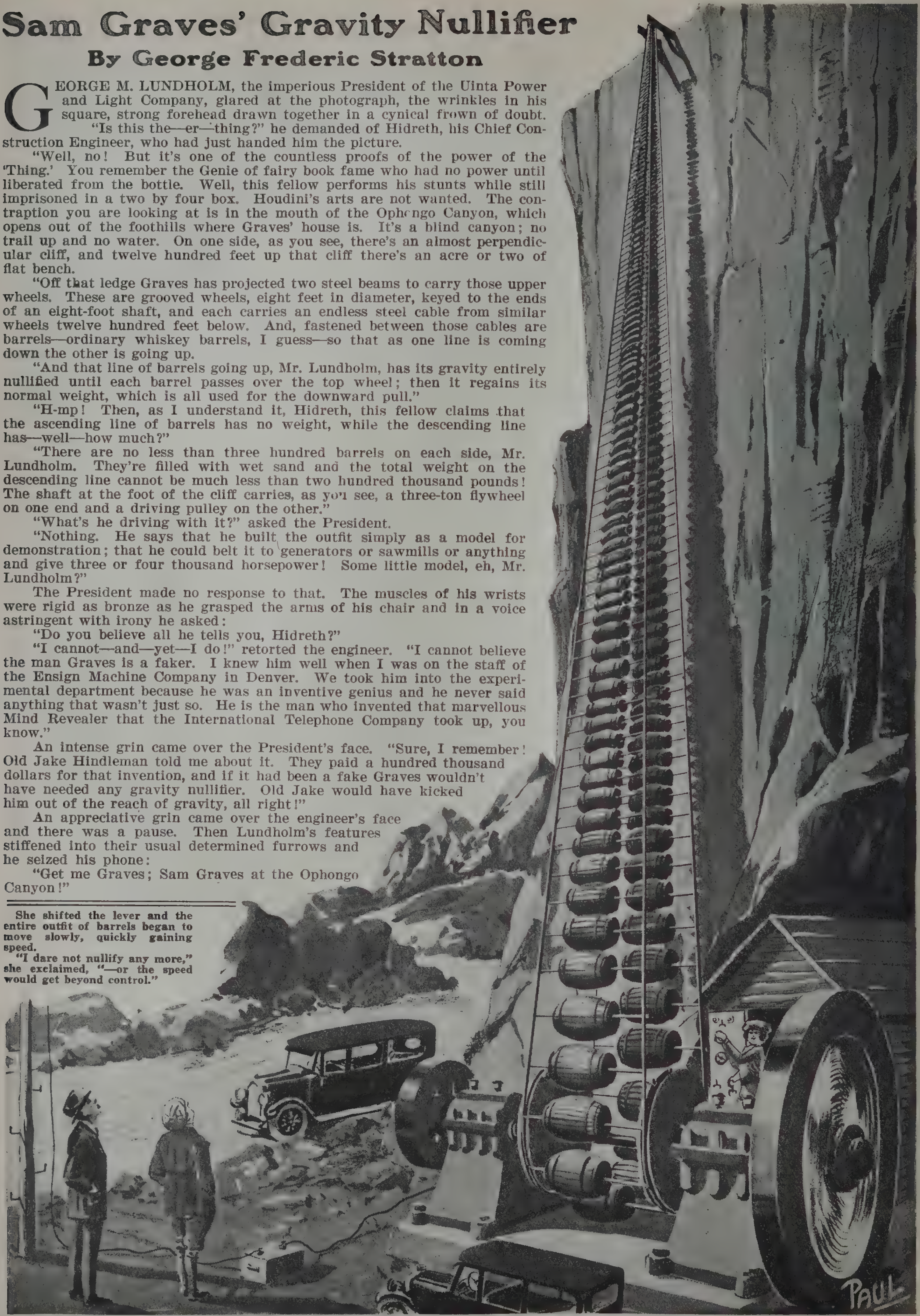
"Do you believe all he tells you, Hidreth?"

"I cannot—and—yet—I do!" retorted the engineer. "I cannot believe the man Graves is a faker. I knew him well when I was on the staff of the Ensign Machine Company in Denver. We took him into the experimental department because he was an inventive genius and he never said anything that wasn't just so. He is the man who invented that marvellous Mind Revealer that the International Telephone Company took up, you know."

An intense grin came over the President's face. "Sure, I remember! Old Jake Hindleman told me about it. They paid a hundred thousand dollars for that invention, and if it had been a fake Graves wouldn't have needed any gravity nullifier. Old Jake would have kicked him out of the reach of gravity, all right!"

An appreciative grin came over the engineer's face and there was a pause. Then Lundholm's features stiffened into their usual determined furrows and he seized his phone:

"Get me Graves; Sam Graves at the Ophongo Canyon!"



She shifted the lever and the entire outfit of barrels began to move slowly, quickly gaining speed.

"I dare not nullify any more," she exclaimed, "—or the speed would get beyond control."

When the connection was made he asked: "Is Mr. Graves there?"

* * * *

"This is President Lundholm of the Uinta Power Company. I've just been talking with our engineer and we'd like to look a little further into your—er—gravity outfit."

* * * *

"Yes; I see. We'll be out there this afternoon."

He hung up his receiver and turned to Hidreth. "His wife answered. Graves went to Chicago on last night's train and won't be back for a week or ten days. But she says that if we go out she can show us the 'controller,' she calls it."

"H-mp!" grunted the engineer, thoughtfully. "I wonder if he's got Chicago parties on the string. I told him I felt sure that you'd look into it without much delay, and he didn't express any impatience at all. Said he thought Denver parties were the logical men to capitalize the thing."

"There he's right!" exclaimed Lundholm. "All the same, I don't like this trip to Chicago. If the thing is genuine—if he can really control gravitation—even in a small degree, it will be the biggest thing the world has ever seen. Mind cannot conceive its limits! And eastern capital is grabbing every good thing here!"

Hidreth nodded slowly. "Say, it gets me the same way. I didn't sleep two hours last night—thinking of it every moment! Almost the last thing I saw before I left Graves yesterday was 'way across the plains a long train of loaded coal cars being started on the track, and the exhaust reports came only about ten a minute. Graves said, indifferently, 'If I went over there with this controller box and connected to that string of cars, with an insulated coupling to the locomotive, it would start them all as easily as if it were only one light caboose!'"

Then, slamming his fist on the table, he added: "And it would, Lundholm, if gravity can be eliminated or controlled!"

The President nodded gravely. Then in a low but intense tone he murmured: "It's no more wonderful and perhaps as possible as sending a hundred thousand horsepower over a wire no bigger than this pencil! Let's go, Hidreth!"

With the President's 12-cylinder car they covered the 30 miles from Denver to the Ophongo Canyon in less than an hour. As they ran slowly up the sage-brush trail from the highway to Graves' bungalow, the inventor's wife, daintily dressed, swung her little figure from the porch hammock and murmured to herself, smilingly: "Here comes the big fellow, Mr. George M. Lundholm, multimillionaire, President of six or eight great companies and on the directorate of a dozen more. Gee! I wonder if I can behave properly and will I be up against the cold, glassy stare?"

She glided down the steps as the car stopped and with a radiant smile said: "I'm not going to wait for an introduction, gentlemen, because there's no one here to introduce me. Welcome to our glorious city, and the rest," waving her pretty arm towards the giant mountains, the snow-tipped peaks glittering in the sun.

Lundholm bowed courteously: "I believe I scowled a little, Mrs. Graves, when I heard that your husband was away; but now I'm intensely glad. I suppose if he had been here we should have gone right on to the canyon and then missed seeing you!"

"That's very nice, Mr. Lundholm. All the same, I'm sorry Sam isn't here. He had to go to Chicago to get some valve or gasket or something for a speed governor he's making for the gravity plant. It's about a half mile up there. Shall we ride over?"

She called to a tall man in overalls who placed a small but heavy box in her own car which was parked there, and started towards the mountains while she entered the President's car. A few minutes over a rough trail of sage-brush and huge boulders brought them to the foot of the stupendous cliffs at the canyon mouth, and a sharp turn at the base ran them close to the huge flywheel on the power shaft.

Edna sprang from the car and tossed a kiss at the two strings of barrels hanging from the curious structure, twelve hundred feet up that appalling precipice. "That's the way I feel!" she laughed. "That's the realization of Sammy's dream, and it's wonderful, Mr. Lundholm; sure wonderful!"

He nodded gravely; a little spasm of indignation sweeping over him that he, a great capitalist, involved in the biggest industries of the West, should be compelled to listen to the "gush" of a bit of a woman like this.

The Crystal Loud-Speaker

YOU know that for years inventors have busied themselves in developing a loud-speaker that would operate from a crystal set without using vacuum tubes. This has actually been accomplished at last and the solution is as interesting as it is elegant. Moreover, the invention is such that it is simple for the average experimenter to build one himself. Read all about this wonderful invention in the March issue of RADIO NEWS.

List of Interesting Articles Appearing in March Issue of "Radio News."

Recent Novelties in Thermionic Tubes for Radio Work.
By J. A. Fleming, D.Sc.
The Development of Wired Radio in Germany.
By Dr. Karl Rottgardt.
Tuning and What It Means.
By John V. L. Hogan.
Another Historic Event in Amateur Radio.
Re-Broadcasting, a New Era in Radio.
The Operation of Close Coupled Transformers.
By W. P. Powers.
Modern Radio Apparatus — Condensers.
By Jesse Marsten.
Building a Neutrodyne and Making It "Neut."

But she fluttered over to a small wooden building, eight by ten feet in size, close to the driving pulley of the gravity plant, followed by the mechanic, who unlocked the door and threw open a shutter across the front of the building.

"This is our control department," she smiled, "and this," pointing to the box which the mechanic had placed on the floor, "is the nullifier—Sam calls it."

With amazing deftness she connected a wire from the electric light service wire to the one end of the box; then connected the other end to a plain switchboard on the wall. There were two circular switch levers. Above one was a rough inscription: "Ascending"; over the other was "descending."

Grasping one lever, Edna replied: "I'll start it, Mr. Lundholm. You see, all the barrels now have their normal weights and of course there's no movement until we cut out some weight from the ascending side. Now look!"

She shifted the lever and the entire outfit of barrels began to move slowly, quickly gaining speed.

"I dare not nullify any more," she explained, "or the speed would get beyond control."

The two men watched intently the now rapidly moving lines and the whirling flywheel. A rude but powerful lever brake was impinging on that great wheel and was being controlled by the mechanic. For a few minutes they all silently watched the movement. Once or twice Edna threw back her switch until the line almost stopped. Then she threw in the nullifier again and speeded up.

"The control's good," she exclaimed excitedly. "If anything was belted on, we could instantly nullify all the gravity from that ascending line and get all the power possible from the descending line. Do you understand?"

"Perfectly," replied Lundholm. "It's quite simple, except one thing; the nullifier. That is an unseen miracle!"

"Seems so to me," she responded. "But then, I'm not a scientist. I haven't the faintest idea how that current is changed in that box to do such marvelous work. I've seen the mechanism and the windings, of course—could assemble it all myself, I think, if necessary; but why or how it acts that way is beyond me. And to tell the truth, Mr. Lundholm, it's beyond Sammy—my husband. He doesn't know any more about that part of it than you or I."

"How was it possible then for him to design or invent the machine—the nullifier, Mrs. Graves?"

"How was it possible for Marconi to devise wireless?" she retorted with a bewitching smile, "or for other big scientific men to send millions of horsepower through a tiny wire? They don't even know yet what the juice is, do they?"

Lundholm nodded gravely. "That is about so, Mrs. Graves."

She added earnestly: "They have found that current would rush itself over a wire, but they've never found out *how*."

"I'm going to show you something else," she smiled. "You don't know now, for sure, that the gravity is really eliminated from some of those barrels. There may be some fake, don't you think? I'll show you!"

She rapidly disconnected the nullifier and ordered the mechanic to carry it over to the President's big car, following it herself with a small coil of wire. The mechanic ascended the electric light pole and connected one end of that wire while she quickly connected the other end to the nullifier and the nullifier to the rear of the car.

"Don't fear for your car, Mr. Lundholm. We've tested it with our own a score of times!"

Pulling on a big rubber glove she grasped the front end of that car and lifted it as high as her sparkling eyes. "It doesn't weigh a pound, you see. Try it yourself!"

He did so and the keen estimating look which he had worn before and which was not without a touch of hard suspicion, disappeared. In its place came a glare of utter amazement as he lifted the end of the great car as high as his head, without an effort.

He relinquished it to Hidreth; strode over to Edna and held out his hand. "I'm thoroughly convinced, Mrs. Graves! Thoroughly! That test is absolutely conclusive!"

She disconnected the nullifier again and the man took it to her car. The two engineers had strolled over to the foot of the barrel outfit, silently gazing at it.

"It's a crude arrangement," she said as she joined them. "Those barrels were

(*Continued on page 276*)

New Things Electric

The Soul Searcher

Left. Portrait of Dr. Albert Schneider with apparatus giving electric registration of psychical excitation.

Right. Ship scraper operated by electric motor, preparing a surface for painting.

WE show a portrait of Dr. Albert Schneider of the University of California. He appears at his laboratory table engaged in a branch of experimental psychology.

It is well known that any excitement of the mind is transmitted to the motor nerves and that distant members of the body respond to mental excitation. A delicate galvanometer is the basis of the apparatus; the last named is the final improvement in the detection of minute electrical currents or potentials.

The subject of experiment may be exposed to various tests and the term "soul searcher" has been applied to it, with the idea that the apparatus can be used to withdraw the truth from criminals. A mirror galvanometer is used. The suspect is directed to utter words quickly, and the degree of electrification which ensues, is an indication of the state of his mind when uttering the tell-tale words.

Electric Ship Scraper

AN old sea refrain ran, "Six days shalt thou work and do all that thou art able, and on the seventh holystone the deck and pound the chain cable."

It is not only the chain cables of the ship that the sailor can exercise his cleaning abilities upon, but the sides of the vessel have to be scraped also to remove rust and old paint, and to make them comparatively smooth for repainting.

This is very laborious work when done by hand scraping. Here we see an operative cleaning the side of the ship with an electric scraper, increasing the speed of the work greatly and also doing away with the laborious feature.

As the scales of rust and old paint fly about through the air, the workman's eyes are protected by goggles.

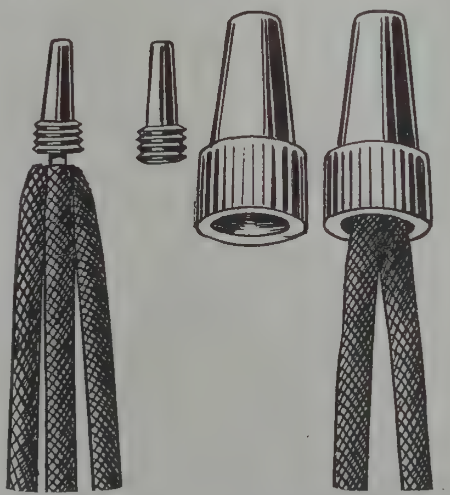
Wire Connectors

FROM Holland comes a box of what are termed "American Connectors," very neat little porcelain cones with an interior element in the shape of a slightly coned brass tube threaded inside and out, screwed into the base as shown in our illustration.

The connectors are shipped in boxes containing about one hundred; each one is a shade over an inch long and half an inch in diameter, and to use them one proceeds as follows:

The ends of the wires to be joined are stripped of insulation for rather less than half an inch, and are laid side by side, pointing in the same direction, and are twisted together. They should then be of such diameter as to fit the interior of the brass tube within the porcelain cone. If not, one or more of the wires may be bent back upon itself and twisted in with the others.

The projecting ends, twisted and stripped, are then thrust into the brass tube of the porcelain cone and screwed home. The thread on the inside of the brass cone takes a good hold on the copper, so that a very solid joint is the result, and one in which there is absolutely no bare wire exposed in any way.



Very convenient system of electrical connection for wires, providing perfect insulation and protection from all contact with operator.

This device eliminates the necessity of solder, for it gives perfect electrical connection, as the conical shape of the connecter presses the twisted wires firmly together.

The little cones of porcelain come in a box all neatly put in place like pieces of candy. Each one contains within it the little brass thimble with a screw thread outside to catch the porcelain, and another inside which cuts into the wire when screwed therein. The one criticism which can be made is that it does not give an end-on connection, but the fact that all metal is entirely concealed and cannot by any accident be touched so as to make a short circuit or occasion other trouble. shows how extremely useful they are and how very effectual they will be for experimenters.

Electric Sander

SANDPAPER or as our English friends term it, glass paper, has long been used for smoothing off the surface of wood. If the stroke is given across the grain of the wood, in many cases a better result is obtained than when the stroke is parallel to the grain.

One of the modifications of the process is to have the sandpaper operated by machinery and in the illustration we show an electric motor which turns a drum covered with sandpaper.

The apparatus, which is small and not unduly heavy, is moved about over the surface to be treated. It is so arranged that each cut given by the sandpaper overlaps the preceding one. As the paper in use eventually gets worn and loses its adhering sand or abrasive, the machine is arranged to constantly change the sandpaper so that a fresh surface is in continual action.

Current is supplied from an ordinary wall plug; the depth of cut is adjustable by a screw below the handle, and the work is controlled by pressure on the handle. It contains a one-third horsepower motor.

Electrical sanding machine used by hand to smooth off wood surfaces, such as table-tops, leaving a very fine finish, which can be regulated by the coarseness of the sandpaper.

Electric Barbecue

OUR illustration shows an improvised electric oven, in which over a ton of beef was roasted at once.

Four steers furnished the beef, each weighing from 500 to 600 pounds dressed, making the total amount of beef barbecued between 2,000 and 2,500 pounds. The number of people fed at this barbecue was between four and five thousand. The details of the heated pit in which the meat was electrically roasted are as follows:

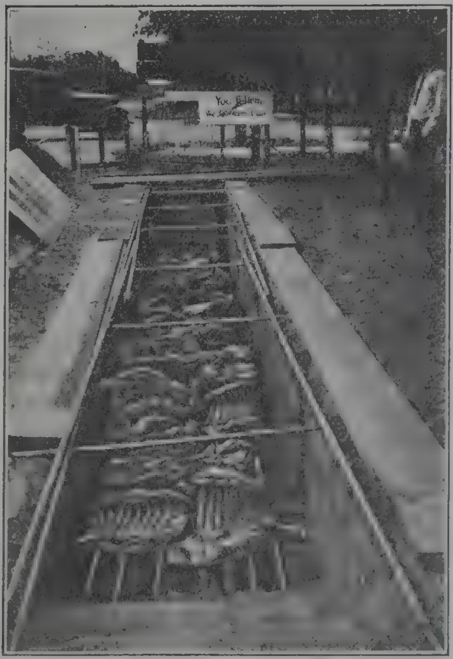
The improvised oven was 32 feet long, four feet wide, and six feet deep. Heating of the pit was accomplished by twelve heating elements, each of three kilowatt capacity. Each heating element consisted of about 175 feet of No. 14 iron wire wound into a coil. The finished coil was about nine feet long and one inch in diameter. These twelve coils were placed about a foot from the bottom of the pit, and sheet iron heat deflectors were placed about six inches above them. One and one-half feet above the deflectors were placed iron bars to hold the beef. The coils were wired so as to give six different heat controls and an electric thermostat was placed in one end of the pit so as to be able to regulate the temperature without the oven being opened.

After the meat was placed in the oven cross bars were placed on top of the pit and on these cross bars were laid strips of sheet iron so as to entirely cover the pit. About one inch of loose dirt was placed on top of this sheet iron to act as a heat-insulator in order to retain all possible heat in the oven. Heat was turned into the oven 24 hours, before the meat was to be served. A temperature of about 550 degrees was maintained for the first two hours, so as to sear over the surface of the meat and retain the juices. The temperature was then reduced to about 350 degrees and held at this heat for about four hours, and then reduced to 250 degrees and held for about six hours. The temperature was finally reduced to less than 200 degrees, and kept at this point until the meat was to be served. During the entire period that the meat was on the entire oven was kept sealed except for a small opening at one end, which opening was left so as to be able to determine when the meat was fully roasted. None of it was touched except the one piece which was tested from time to time to determine how the roasting was proceeding.

While the electrical barbecue was the first of its kind the construction of the improvised oven cannot be termed strictly new. The design of the oven follows closely the design of the electric oven of the Westinghouse automatic range and the Hot Point Hughes automatic range. The main factor in staging this electric barbecue was to demonstrate the perfect results obtained in the modern electric range oven.

The results obtained in this improvised oven really exceeded expectations. When the meat was removed from pit it was found that all was perfectly roasted.

Contributed by H. I. Klehm,
Washington Power Company



Using electricity for cooking on the grand scale. The beef from four animals was cooked in this gigantic electric oven, a great contrast to the work of the oven next described.

How I Would Talk to Mars

By Mr. H. Gernsback

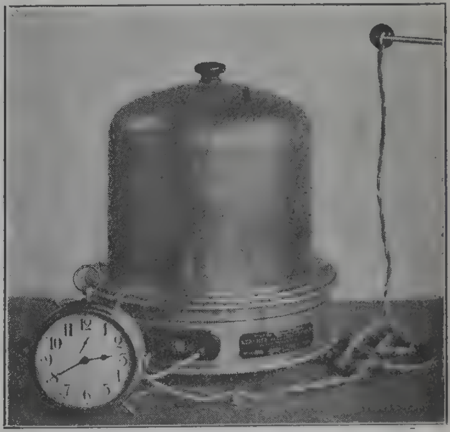
THIS year Mars will be in opposition. It will come a little over 35,000,000 miles nearer to the earth. Shall we succeed this time in establishing communication with this mysterious planet? Mr. H. Gernsback proposes a very novel scheme, and that is actually to SPEAK to Mars over a light beam; not just flashing or signaling; but sending speech and music over a ray of light. This is possibly the most novel scheme or plan that has ever been proposed for establishing communication with a celestial body. Do not fail to read all about it in the March issue of Science and Invention.

List of Electrical Articles Appearing in March "Science and Invention."

Speaking to Mars Over a Light Beam.
By H. Gernsback.
Electric Servant Girl of Tomorrow.
Electricity in the Stock Market.
By W. B. Arvin.
Sub-Conscious Code Teaching.
By D. W. Hathaway.
Miscellaneous Electrical Articles in How-to-Make-It and Constructor Departments.
Non-Radiating Receiving Sets. Extremely important and timely article. Don't miss it!
Latest Patents.
The Oracle and Patent Device Departments.

LOOK FOR THE GOLD COVER

Portable Electric Oven



A small electric oven of rather captivating appearance, which can be operated on a table, is turned on by an ordinary alarm clock. This is cooking on a small scale.

ONE of the peculiarities of electricity in the house is that by its use all sorts of operations can be carried on in various places. Cooking is not restricted to the kitchen range, ironing is done in any room where a socket can be found to connect the flexible cord to, and toast is made on the breakfast table.

The oven which we illustrate is simplicity itself; in the cylindrical base there is a heating coil, above which comes a receptacle for the things which are to be cooked and a bell shaped cover surmounts the whole, to keep in the heat and avoid the dissemination of cooking odors.

There is a thermostat switch which prevents the heat from exceeding a definite amount. If it opens and cuts off the current, the temperature falls, and like every other thermostat switch it closes the contact and current again passes. Alongside is seen an ordinary alarm clock. This has a connection to a switch so as to turn off the heat at any desired time.

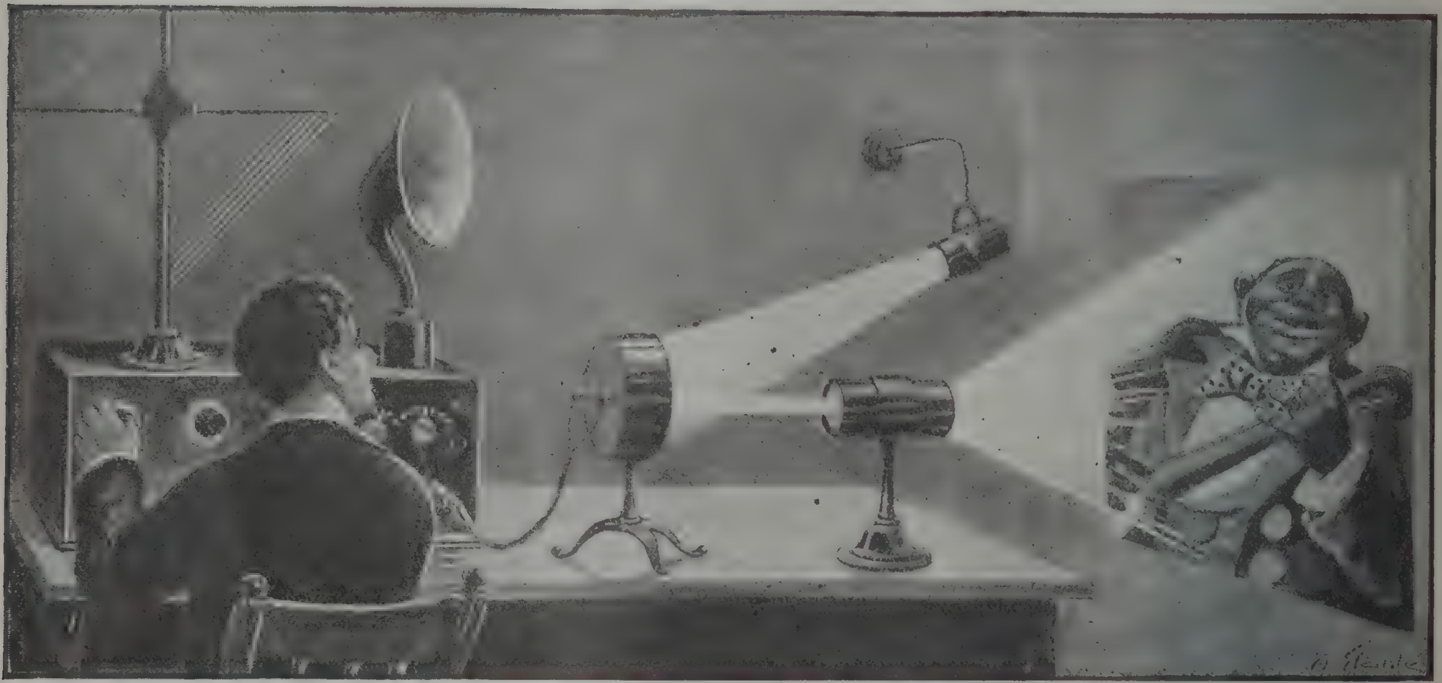
It would seem to be but a little advance to arrange the clock to turn the current on at any desired time, as well as to turn it off.

One of the peculiarities of household electric appliances is that they are always open to improvement and modification. For this reason our suggestion may be acceptable as this timing is done on other ovens.

Experimental Electrics

Television by the Belin System

By Lucien Fournier



Operator with Belin television apparatus watches antics of a comedian, who is really performing at a distance and whose image is transferred by wireless.

VARIOUS apparatus for television have been invented up to the present time, and we are on the point of solving this interesting problem for whose solution humanity has waited with so much impatience ever since the invention of the telephone, and especially since the development of radio.

We are insatiable; like children spoiled by their parents, we must have something better all the time, and curious to remark, it is always in the poorly cultivated classes that we encounter greatest desire, it is they who complain the most of the slow pace of progress.

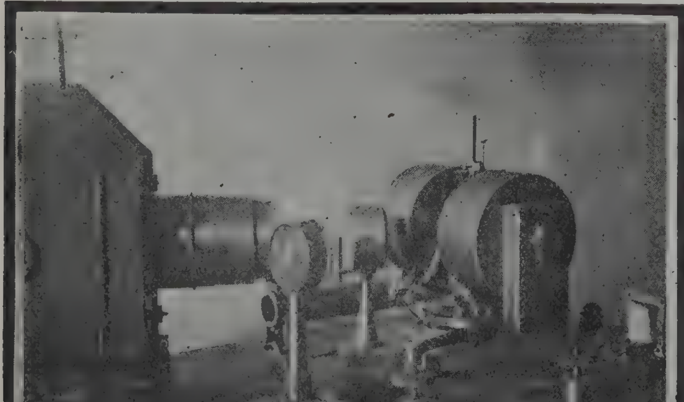
At least in France is this the case. I would be greatly surprised if the same phenomenon is not encountered in the United States, where the thirst for invention is greater perhaps than in other countries.

However, this may be, Edouard Belin, well known in the transatlantic countries by his experiments in radio telautography, because it is from the United States that he has sent by ether waves his first autographic dispatch into France, is engaged with the problem.

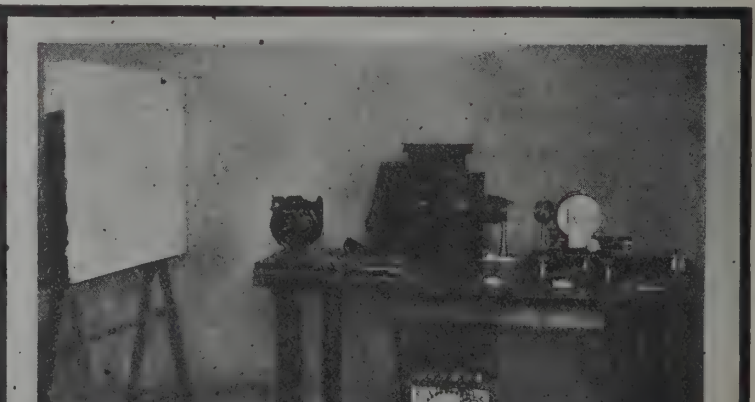
The production of television as treated by Edouard Belin, has not yet reached the degree of perfection equal to that of his preceding achievement. Nevertheless, the illustrious inventor succeeded recently in a remarkable experiment, which consisted in transmitting by wireless a luminous crown.

He started with the principle, that, if it were possible for him to transmit a luminous point in a period of time shorter than a tenth of a second, he could effect television, which becomes in fact telecinematography. Here is how it works.

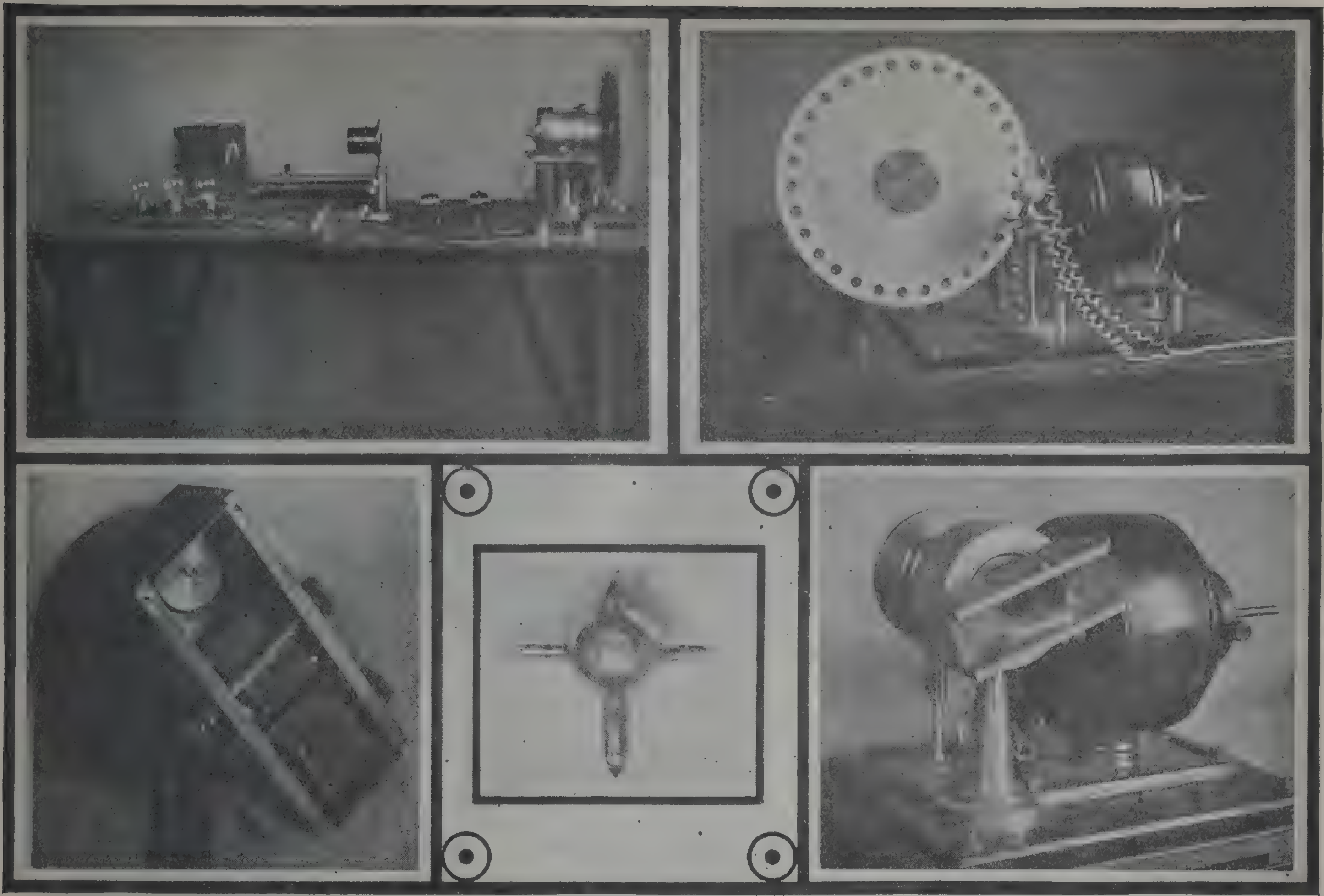
An incandescent lamp projects a luminous crown on the screen, Figure 1 in diagram. From this crown by the use of a photographic objective, he selects a point which he projects upon a first prism. The light is reflected to a second prism, which sends it on through the holes in a rotating interrupting disc, upon a substance sensitive to light. This substance



Details of receiving apparatus showing the Oscillograph, objective, projecting apparatus and other details.



Complete receiving apparatus showing projection of arc upon screen at a distant station.



Upper left. Transmission apparatus showing arc to be transmitted to a distant station. Upper right. Shutter disc and photo-electric bulb, the latter without lag as described in article. Lower left. Prisms in rotating case. Lower center. Photo-electric bulb, working without lag. Lower right. Motor and case for rotating prisms.

is connected to a wireless telephonic transmission apparatus of the ordinary description, which discharges waves into its antenna.

The prisms are enclosed in a rectangular box which can be revolved about its axis, which box has a tubulure facing the disc, and through which as our diagram shows, the luminous rays pass. If the prism were turned around, the upper prism (A), will range over all the luminous points constituting the luminous crown, and will project them on the photosensitive element, which would transmit a continuous current to the antenna, because all the luminous points have the same intensity.

But if we interpose a perforated disc in the path of the reflected rays, and if the disc is turned, we will produce emissions and interruptions of light at longer or shorter intervals, according to the rapidity with which the disc turns. The photoelectric element will then send out rapidly pulsating currents into the aerial of the transmitting station, which will excite in the ether the formation of waves succeeding each other with the same rapidity as that of their formation.

If all the luminous points which compose the crown are transmitted in less than one-tenth of a second, we can perceive on their reception, no longer a series of luminous points, one closely approaching the other in point of time, but a veritable crown of light, based upon the principle on which the cinematograph rests, the persistence of luminous impressions on the retina.

Let us now see how this transmission and reception are carried out. In the first place, it comprises an ordinary wireless telephone transmitting system, whose two terminals are connected, not to a telephone receiver, but to a reflecting oscillograph. A beam of light falls upon this mirror through the apparatus shown in diagram, Figure 2. This mirror reflects the beam upon an objective, then on a system of prisms similar to those already described, and which can be revolved about its axis. The second prism reflects the beam upon an opaque screen.

As we have transmitted a series of luminous points separated by minute periods, the mirror of the oscillograph will always be acted upon by currents of equal value, each point of light always having the same intensity, and the reflected beam will be subjected to a series of equal vibration.

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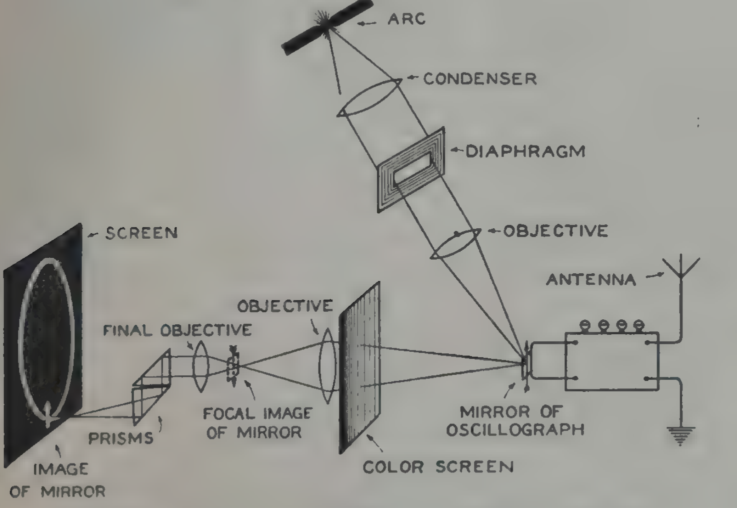
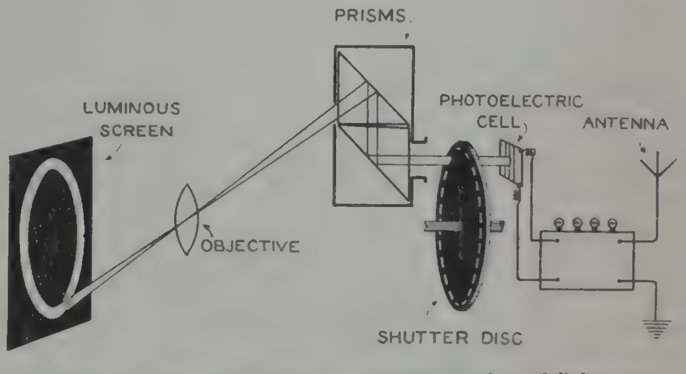
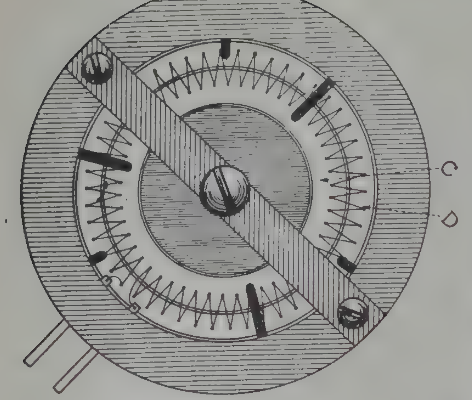


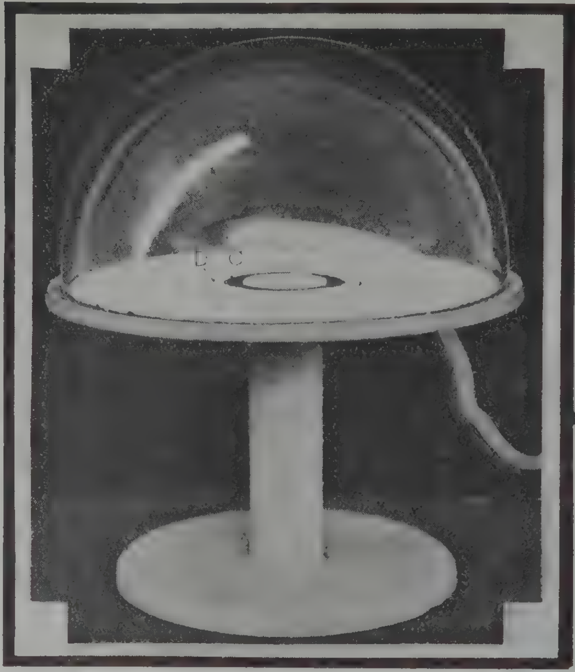
Receiving apparatus in full detail. On screen is seen image of luminous circle.

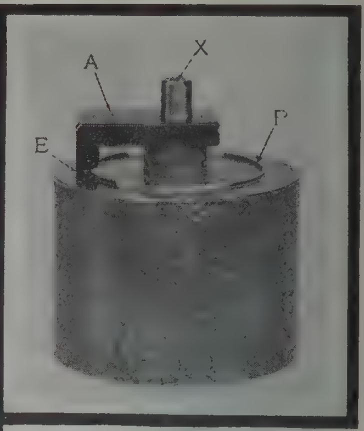


Transmitting apparatus acting by intermittent pulses of light upon photo-electric cell.

Solar Radiation Measurement







Left. Arrangement of thermopile and supports for two rings, one black and one white.

Center. Complete apparatus for measuring solar radiation, protected by glass shade.

Above. Welding extremities of the wire by rotating electrode.

Below. Dark and light colored rings for producing thermopile action.

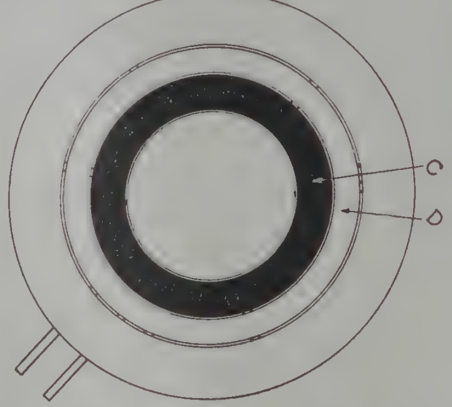
An instrument for giving continuous records of the intensity of the solar radiations, has been constructed under the auspices of Messrs. Kimball and Hobbs of the United States Weather Bureau.

The interesting part of the apparatus is the potential generator, some of the particulars of whose construction we give here. A thermopile is made up of short wires held together at their ends by electric welding; one set of wires consists of an alloy of 60 per cent gold and 40 per cent palladium, the other of an alloy of 90 per cent platinum and 10 per cent rhodium. One pair of wires were drawn down to .0008 in diameter, the other pair to .0016 inch.

The alternate ends of the wires of the two different alloys as eventually connected, and the layout of the set of thermocouples constituted by them, are shown in one of the illustrations. In making up the thermopile a pair of dissimilar wires had their ends twisted and fused electrically. It was found that the best way to do this was to do it with the ends coming from the spools of wire, and when the electric fusion was completed, the wires were cut off to a proper length. When enough couples were thus accumulated, and fifty were eventually required, they were laid aside for the moment.

A bakelite case, which is a thick cylinder, has six little supports projecting from its inner surface radially; three of these supports carry one copper ring marked (C); the other three carry a concentric ring of smaller diameter marked (D). The rings are thickly varnished with bakelite varnish or shellac.

The pairs of wires are now attached to the inner ring marked (C) and varnish is put over each of the junctions. The copper ring (C) is blackened with lamp black. The other ring is whitened with enamel and magnesium oxide giving a firm coat.



The outer junctions of the couples have now to be welded together; each pair of outer junctions is twisted together and the arm (A), connected to a circuit of electricity is rotated, and in its travel comes in contact with the twisted junctions one by one, melting the wires back to the end of the arm at (E), usually forming a little bead of metal.

The apparatus is now complete; it is mounted on a support and covered with a hemispherical glass shade. When sunlight falls upon the surface, the blackened ring becomes hotter than the whitened one, so that a potential difference is established of from five to ten millivolts.

We refer to the diameter of the wires as being .0008 or .0016 inch. Thermopiles were made of wire of both diameters.

We show the apparatus on a fixed mount, but sometimes it is mounted on a clock-driven equatorial tube to measure the direct solar radiation only.

The resistance varies from 137 ohms to 326 ohms for the thinner wire; for the thicker it may be 86 ohms.

Television by the Belin System

(Continued from page 245)

There will be seen in our diagram the gamut of tints, a screen of glass of intense black at one end and transparent at the other, so that the reflected ray will pass every time from intense black to absolute transparency. The beam of light will be received by the rotating prisms only when it will have passed the transparent part of the graduated glass screen. As fast as the prisms turn they will project all the luminous points on the screen, one following the other; we have said that the perforated disc of the transmitting station makes one complete turn in less than a tenth of a second. Consequently all the luminous points succeed each other on the screen with the same quickness and thanks to the persistence of the luminous impression on the retina, they will all be received by the eye in less than a tenth of a second.

In practice the arrangements are not so simple as they appear in our explanation. Mr. Belin admits that an image one millimeter square, (about one twenty-fifth of an inch) is reproduced by a minimum of twenty-five luminous points. A proof of a cinematograph film eighteen by twenty-five millimeters (about three-quarter inch by one inch) will be composed of 11,250 points.

If all the luminous points composing this image are grouped upon the receiving screen, it is necessary that the last of these points shall make its appearance before the luminous impression of the first one has left the retina; only on this condition will the observer have a complete vision of the picture at the sending station. This amounts to saying that in a period of time, which must not exceed one-tenth of a second, 11,200 emissions must be received by the optical apparatus at the receiving station, that is to say, the modulations corresponding to the basic frequency of reception must be at least this number in the tenth of a second, or 112,500 each second.

And this figure is a strict minimum for it is incontestable that for the action not to be fatiguing and for the reproduction to be more perfect, the sum of the images should succeed each other in an even less period than a tenth of a second.

On the other hand, as the twenty-five points to the square millimeter are a little coarse, they will have to be brought closer together in practice, and there seems to be no exaggeration in saying that the emissions should succeed each other with a frequency of 200,000 per second.

But because selenium cannot be used at such high frequencies on account of its lag, Mr. Belin has replaced it by a photoelectric bulb, shown in one of our illustrations; it is a bulb silvered on its inside surface except for a spherical segment in front through which the luminous rays pass. It is filled with hydrogen at a very low pressure, contains a potassium anode, and a cathode grid of nickel and platinum. The two electrodes are connected to the two poles of a source of electricity and current passes the instant the ray of light reaches the bulb. The sensitivity of this apparatus is prodigious; the light of a star of the sixth magnitude affects it. Its lag is practically nil; it is estimated as not exceeding a ten-millionth of a second. Now we know that it is sufficient for us to have a lag, not exceeding the two hundred-thousandth of a second for attaining television. We see that in these conditions this curious problem is due to receive an early solution.

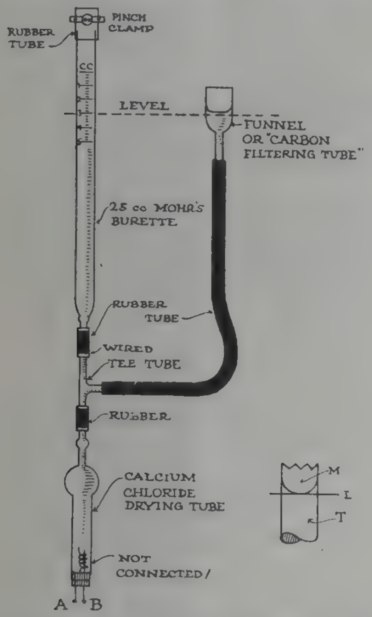
Simple Gas Voltameter

By Raymond B. Wailes

EXPERIMENTERS have often constructed indicating instruments which operate upon a qualitative basis, but do not measure quantitatively, the units by which they are affected.

A simple device which can be made from easily procured parts is described here by which the quantity of electricity passing through the instrument can be calculated with a high degree of accuracy. When the instrument referred to, which is the gas voltameter, is connected in series with a source of current and an ammeter to be calibrated for amperes so as to be included in the circuit, the accuracy of the ammeter can readily be found by calculation from a simple formula.

The principle upon which the gas voltameter operates is founded upon the electrolytic dissociation of acidulated water into oxygen and hydrogen gas, the resulting gases being measured under standard conditions of temperature and pressure, the quantity of combined gases being a measure of the coulombs which passed through the voltameter during the "run" or period of test.

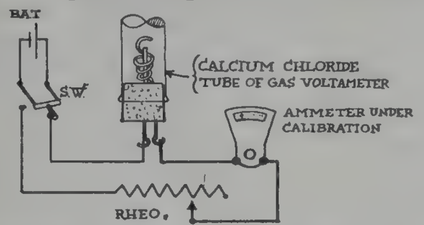


Gas voltameter. This instrument gives the coulombs of electricity which are passed through a solution which is in circuit with the instrument to be calibrated. The readings of the fluid electrolyte vary with the ampere-seconds.

A 25-cubic centimeter Mohr's burette serves as the measuring tube. This instrument should be divided off into the smallest graduations possible, such as 0.05 cc. If it is of the usual type, which is divided into tenths of a cubic centimeter, it will serve about as well.

A ¼-inch glass tee tube is fitted to the lower end of the burette by means of a short length of rubber tubing, and to the side arm is attached a length of rubber tubing about two feet long to which is fitted an ordinary funnel, separatory funnel, or carbon filtering funnel.

The lower end or outlet of the tee tube connects with the small end of a one or two-bulb calcium chloride tube, commonly called a drying tube, by means of a short length of rubber tubing. The larger end of this calcium chloride tube is fitted with a sound cork or rubber stopper through which platinum wires pass. This is if acid is used in the burette. Alkaline solution may be used with iron wire electrodes. They should not be connected with each other in any way. A short length of rubber tubing is to be fitted over the upper end of the Mohr burette and a pinch cock placed on the rubber tube; this enables it to be closed at will. A cork, with a short length of glass tubing thrust through it, can be fitted into the upper end and the short length of rubber tubing and the pinch clamp fitted to it if desired.


BAT
S.W.
CALCIUM CHLORIDE TUBE OF GAS VOLTAMETER
AMMETER UNDER CALIBRATION
RHEO.

Enlarged view of the calcium chloride tube, ampere meter to be calibrated and accessories for operating the voltameter.

Setting the Voltameter at Zero

The whole apparatus is filled with water containing several drops of sulphuric acid to make it conductive to the current. It will be found that with the upper pinch cock open, the level of the liquid in the burette can be raised or lowered by raising or lowering the funnel on the right-hand side of the apparatus. Adjust the funnel so that the acidulated water in the burette stands at zero, and then close the pinch cock. Be sure that when the pinch cock is closed, the level does not recede due to compression of the air above it. The funnel or leveling tube should, of course, be held stationary by means of a hook on the wall or a stand.

The gas voltameter should be connected in series with a cell such as a storage battery, a switch, a variable resistance and the ammeter or other current indicating instrument to be checked for accuracy or to be calibrated as shown in the figure.

With a watch, close the switch when the second hand is over a second mark and allow the current to flow for about a minute. Note the reading of the ammeter during this "run" or test. Open the switch at the end of about a minute, or until about 15 or 20 cc. of gas have been evolved. The time must be accurately taken.

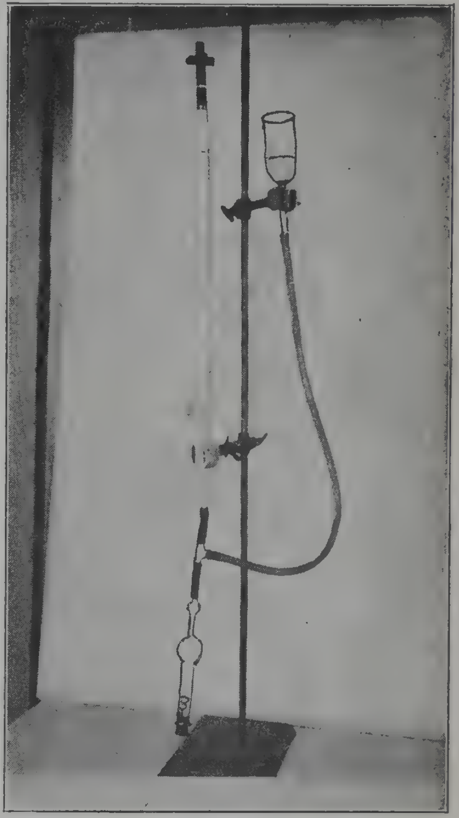
During the "run," hydrogen and oxygen gas are evolved by the decomposition of the acidulated water. The two gases pass upward through the liquid and collect in the top of the measuring burette with the air that is already there. The liquid flows from the burette into the funnel on the right-hand side of the drawing. At the end of the run, the funnel is lowered until the level of the liquid or acidulated water in the measuring tube is along the same straight horizontal line as the liquid in the funnel. Holding the funnel close against the burette so that the two levels can be made to coincide, read the volume of the gas now in the tube. If the tube was set exactly at zero at the start, the reading now read off will be the volume of gas in cubic centimeters (cc.) of gas evolved.

Variation on the gas voltameter; the weight of metal deposited is weighed on an accurate balance and this weight varies according to the ampere seconds also.

To calculate the amount of current which passed through the circuit during the run, use the following formula:

$$\text{Amperes} = \frac{\text{Volume of gas}}{.1733 \text{ times} \pm \text{seconds.}}$$

The factor 0.1733 is the number of cc. which one ampere liberates or evolves when passing through acidulated water for one second. This is one coulomb. So, if the volume in the burette at the end of the run read 15 cc., and the time in which the current was flowing or the switch was closed was three minutes (180 seconds), the current in amperes flowing through the circuit would be: 15 ÷ (.1733 times 180) = .48 ampere, or nearly half an ampere. The number of minutes have to be multiplied by 60 to convert them into seconds. If the home-made ammeter connected in the circuit during the run reads a certain number on its home-made scale, this figure or number should be lettered .5 or .48, according to the sensitivity of the instrument. If an instrument reads wrong, it should be recalibrated.

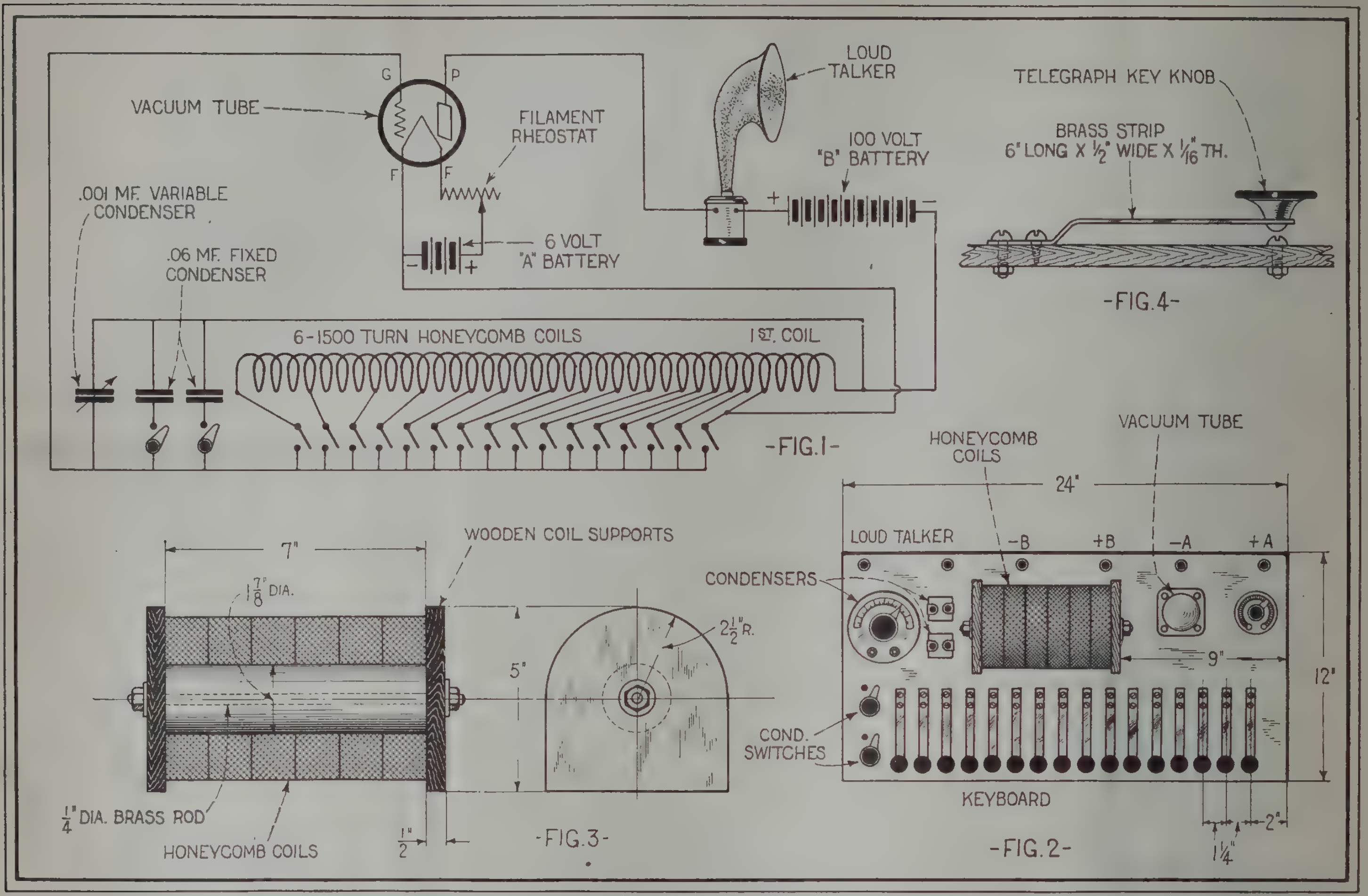


Complete reproduction of the gas voltameter mounted and ready for use.

Another method used in ascertaining the current strength is by means of the weight voltameter. This consists of two metal plates such as copper immersed in a copper sulphate electrolyte or solution. When the current is passed, copper deposits upon the negative plate. In order to find the actual current strength, the increase in weight of the plate is found. This is performed with the aid of a sensitive balance, the plate being thoroughly cleaned before the test or run, and carefully dried after the run. The number of grams of copper deposited gives the coulombs.

The Staccatone

By Clyde J. Fitch



Various views of the new electrical instrument, the Staccatone. A single vacuum tube is made to produce music, really a version of the so-called static sounds which sometimes arouse the ire of the wireless operator. The instrument is compact and produces sounds of considerable intensity and of good characterization.

HAS it ever occurred to you that the squeals and whistling noises which you hear in your radio set while trying to tune in a distant station may be controlled so as to produce pure musical tones; and that with a vacuum tube, a few coils and condensers a simple musical instrument is easily made, on which any song or tune can be played?

The characteristic squeal rising in pitch from zero to a note beyond the limit of audibility is familiar to all of us. This range of frequencies runs much higher than can be obtained from any known musical instrument. If properly controlled we have a musical instrument that surpasses in tonal range any other musical instrument, and the note is exceptionally pure, practically free from harmonics. Of course, with several vacuum tubes harmonic chords could be played. With the single vacuum tube musical chimes and tunes can be played that are very pleasing to the ear when played alone or in connection with an orchestra. The experimenter will find much amusement in one of these musical oscillators, and if he is careful in tuning it he will find it in great demand by dance hall orchestras where novelties are the chief attraction. The public always wants something new.

The squeals heard in radio sets are caused by the interference of two waves of different frequency setting up an audible beat-note, and squeals are difficult to control, as the slightest change in the capacity of the apparatus, such as is caused by moving the hand near the set, will change the pitch of the beat-note considerably. As this system would be impractical for our purpose we shall use a vacuum tube connected so as to generate low or audible frequency notes which sound the same as the beat-notes heard in radio.

The Staccatone

is a brand new musical instrument, the idea of which originated with Mr. H. Gernsback, Editor. The instrument is nothing more nor less than a modified radio oscillator such as is used in the laboratory for testing purposes.

The instrument was first used publicly by Mr. Gernsback last November while broadcasting from WJZ. Many inquiries were received asking for a description of this weirdly sounding instrument. The new musical instrument, called Staccatone by Mr. Gernsback on account of its staccato-like flute sounds, was developed by Mr. Clyde J. Fitch, and a full description is contained in the accompanying article. With the Staccatone entirely new sounds can be produced, which can easily be heard several blocks away. The sounds of the Staccatone are pleasing to the ear and very clear, the notes at the same time being very pure.

The Staccatone will shortly be used publicly by Dr. Hugo Riesenfeld, well-known conductor of the Rialto Theater, New York City, where it will be heard in connection with the whole orchestra.

Up-to-date experimenters will have no trouble in making the Staccatone and selling it at a good profit to orchestra leaders.

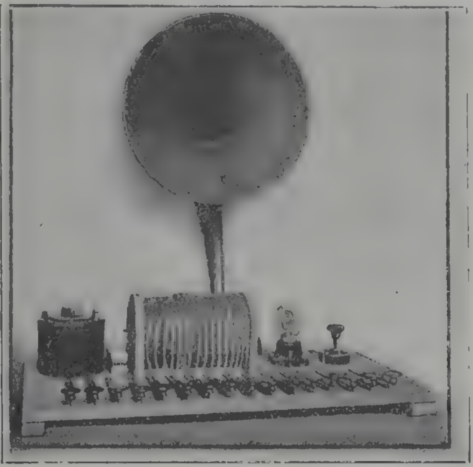
Such a circuit would require larger values of capacity and inductance than are used in the ordinary radio circuit, and for this purpose a number of large honeycomb coils are used with fixed and variable condensers of comparatively large capacities, so that the natural frequency of the oscillating circuit will be at a low audible note. By employing sufficient capacity and inductance in the circuit to give us the lowest note desired we can, with a number of switches corresponding to the keys on a piano, cut inductance or capacity, or both, in and out of the circuit and raise the pitch to any value we wish, each key or switch corresponding to a musical note. The tones are heard, of course, from a loud speaker connected in the plate circuit of the vacuum tube.

The complete circuit is shown in Figure 1. Those familiar with radio hook-ups will recognize this at once as the Hartley circuit. The inductance consists of six 1,500-turn honeycomb coils, all connected in series and clamped together as shown in Figure 3. Care should be taken while connecting the coils so as to make certain that the magnetic fields of them will assist rather than oppose each other, or the circuit may not oscillate. The coils will be properly connected if the outside lead of one is connected to the inside lead of the other, and all are placed so that the wire is wound in the same direction. It will be noted that the negative side of the (B) battery is connected to one of the end coils, which for convenience we will call the first coil. The filament of the tube is connected to the other lead of the first coil, where it makes connection with the second. Taps are brought out and connected to the switch keys as will be described later.

For the fixed condensers about 20 small mica condensers of .006 mfds. each will be required. The variable condenser may be of the 43-plate type. The purpose of the variable condenser is to adjust the apparatus to be in tune with other musical instruments, as it has been found by experience that different tubes and different values of (A) and (B) battery voltages slightly change the frequency of the generated current. Therefore, to tune the Staccatone to other instruments the variable condenser will be found convenient.

The condensers are divided into two sections as shown; the exact capacities of each will have to be determined when tuning the oscillator. With all of the condensers connected in the circuit the note should be the lowest desired. The switch keys are connected at the proper intervals so as to cover one octave including all half notes. Then by cutting out one section of the condensers with one of the left-hand switches the frequency is increased one octave; cutting out the remaining fixed condensers increases the frequency another octave, and with the variable condenser the frequency can be increased to inaudibility.

With the aid of the reproduced photograph and the plan view of the finished apparatus little difficulty should be experienced in connecting and mounting the instruments. Figure 4 shows how the switch keys are made. Everything should be connected but the taps to the coils and the condensers. Six binding posts are provided, for the (A) and (B) batteries and the loud talker. These should be connected up and the tube lighted to test the circuit and determine whether it oscillates. A loud howl should be heard in the loud talker.



Reproduction of a photograph of the Staccatone as it was built in the laboratories of this paper. It will be seen that it is a compact instrument, yet it is one which will give a wonderful volume of sound.

The greatest difficulty is to properly tune the oscillator. If a piano is available this will be a great help. If not, a tuning fork in conjunction with any musical instrument will do. To begin, the lowest switch key, marked No. 1 in the diagram, should be connected to the end of the last coil. Then the condensers should be added until the desired note is obtained, which for best results should be G. The variable condenser will aid in obtaining the correct frequency, and if not it may be necessary to tap the coil near the end rather than at the end turn. Then the next key should be connected by tapping on the coil until G flat is obtained. There is no way of determining the position of the tap—it must be done by the cut and try method. When separating the coils to make the tap, they should be clamped together again when trying the note, as the pitch will be different with the coils separated. The remaining taps are connected in the same manner, so as to form a complete musical scale of over one octave as follows: G, G flat, A, A flat, B, middle C, C flat, D, D flat, E, F, F flat, G, G flat, A, A flat. When so tuned any musical selection can be played.

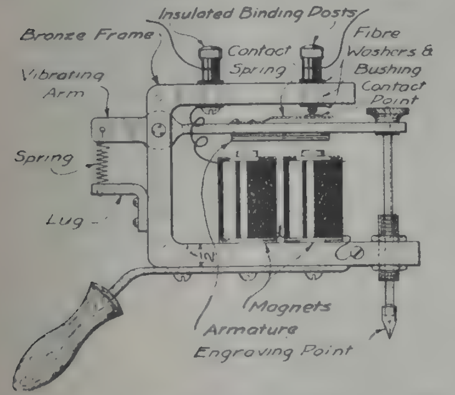
Although not necessary, the complete keyboard can be shifted one octave higher by cutting out the proper number of condensers. The correct number must be determined by trial. By adding more condensers the scale can be shifted one octave lower. By cutting out all of the fixed condensers an exceptionally high squeal can be obtained which will rise to inaudibility as the variable condenser is decreased to zero capacity.

With a six-volt vacuum tube, such as the type UV-201, and a B battery voltage of 90 or more, the sound will be so loud as to be heard for several blocks. Of course, a good loud talker must be used. But for inside use in a small room a dry cell tube may be used with a 45-volt B battery. In fact most of the instruments that are used in radio receiving sets may be employed in the Staccatone.

Electric Engraving Tool

THIS tool can be used by the maker of small engravings, hand-made jewelry, watch cases, etc., to great advantage and it can be constructed by anyone of mechanical ability from material easily obtainable in the line of mechanical work.

The body of the tool consists of a U-shaped piece of metal preferably of bronze or other non-magnetic material. It is designed to be about three inches from top to bottom, the top arm three inches long and the bottom arm four inches long. The stock should be one-half inch thick by one inch wide.



Apparatus for engraving on metal by the production of very rapidly succeeding blows from a sharp steel point. The apparatus is not so complicated as it appears, and is provided with full adjustments.

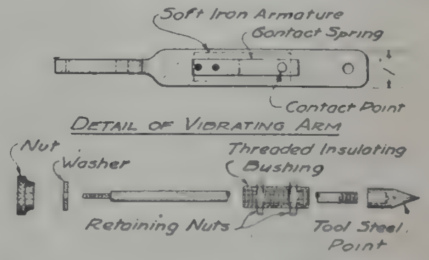
Bolt a pair of good magnets to the inside of the bottom arm about one inch from the back. One terminal should be wired to an insulated binding post on the top arm and the other terminal connected to a set screw in the lower arm. Set another insulated binding post beside the first and fit it with an adjustable contact point which can be raised or lowered by a screw. This should point directly over the outside magnet core.

The vibrating arm is composed of a piece of the same non-magnetic stock shaped as shown in detail. A short section in its back should be flattened and a hole drilled about one inch from the end. Near the center of the main portion rivet a short length of soft iron underneath for the armature and a spring contact above. Tap a small hole in the end. Mount this vibrating arm in a slot cut through the back of the (U) and pivot it through the hole in the flat portion by a rivet so that it will swing easily but without any side play. The contact on the spring and the contact-point screw should then meet. A small spiral spring at the opposite end fastened to a small lug projecting from the back of the (U) is then arranged to keep the arm up at the right tension against the contact screw point.

EXPERIMENTERS and amateurs, we want your ideas. Tell us about that new electrical stunt you have meant to write up right along, but never got to. Perhaps you have a new idea, perhaps you have seen some new electrically arranged "do-funny"—we want these ideas, all of them. For all such contributed articles that are accepted we will pay one cent a word upon publication. The shorter the article, and the better the illustration—whether it is a sketch or photograph—the better we like it. Why not get busy at once? Write legibly, in ink, and on one side of the paper only. EDITOR.

The vibrating shaft is shown in the detail drawing and consists of a steel shaft threaded in the hole in the vibrating arm and working through a fibre non-inductive bushing or sleeve fastened in the end of the lower arm of the (U) by lock nuts. Several engraving points of hardened tool steel should be provided which can be threaded directly on the lower end of the shaft. This shaft *must* be insulated by a bushing or else the machine will short-circuit and not work.

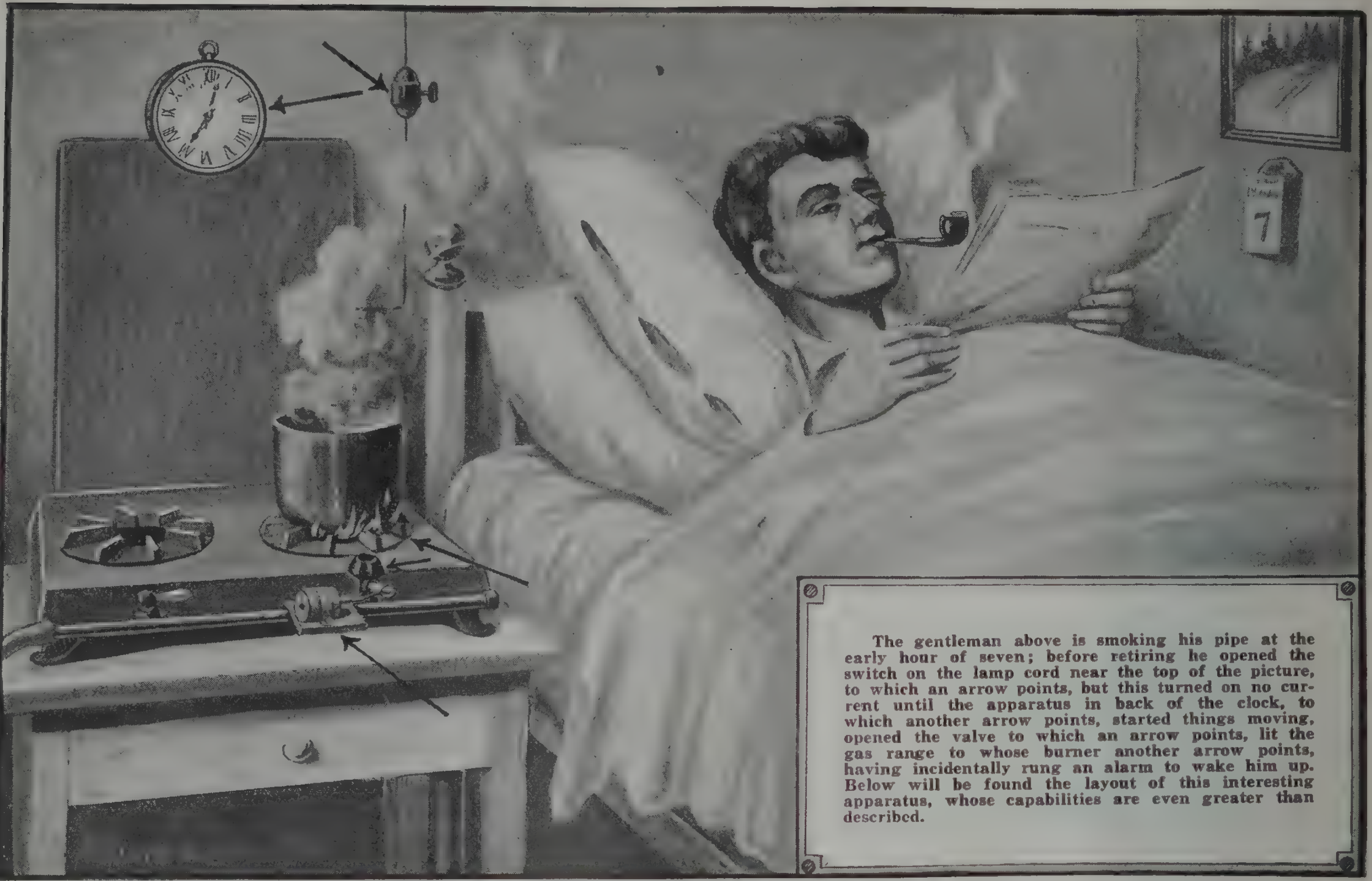
A handle as shown completes the tool, after which it should be connected to the source of electricity and tested out. The current operates this in the same manner as a buzzer or electric bell. It will be necessary to adjust the little spiral spring at the back of the vibrating arm to just the right tension and then the armature will vibrate at its proper speed. This works the shaft up and down in its bushing and by holding the point against the metal its surface will be rapidly cut in any design desired. A low voltage should be used, either taken from a storage battery or cut down from the lighting circuit by means of a transformer.



Details of the important parts of the engraving tool, which are not so clearly shown in the other general view.

Contributed by L. B. ROBBINS.

Alarm Clock Relay



The gentleman above is smoking his pipe at the early hour of seven; before retiring he opened the switch on the lamp cord near the top of the picture, to which an arrow points, but this turned on no current until the apparatus in back of the clock, to which another arrow points, started things moving, opened the valve to which an arrow points, lit the gas range to whose burner another arrow points, having incidentally rung an alarm to wake him up. Below will be found the layout of this interesting apparatus, whose capabilities are even greater than described.

THE following describes a very comprehensive alarm clock, one which does more than alarm. The writer has used it for several months and finds it very efficient.

In the drawing is seen an alarm clock. The bell was removed and a brass strip about one-half inch wide was secured around the clock to hold it on the wooden base, which is nine by twelve inches and three-quarters of an inch thick. The board was painted several times with shellac. It should be of good material.

Two switches are used in the battery circuit. The cut-in switch is placed in the rear of the clock; the handle is removed and a piece of brass is bent in a hook-shape one inch from the center of the hole to the inside of hook and the handle is replaced.

The cut-out switch is placed beside the clock in front of the base. This switch is used to stop the bell from ringing and to cut out the relay.

The relay is of buzzer or bell type with bell removed; the clapper ball is cut off and the stem is shortened as in the illustration.

The magnets are in series with the bell circuit and the leads go direct from the outside of the magnets to binding-posts. Copper strips one-sixteenth inch thick, three-eighths inch wide and two inches long, bent upward about three-eighths inch so that the bell clapper can rise and slip from under the arm are provided. A set-screw for the contact point of the bell is placed as shown.

The lug is three-quarters inch in width, one inch long and bent to a sharp angle in the middle, so that the contact point can rest on it.

Then a small spring is fastened to the buzzer armature so as to pull it over and lift the arm and break the 110-volt circuit.

The 110-volt magnet speaks for itself; it also rests upon a wooden base, heavily shellacked and thoroughly dried.

The magnet is mounted so as to pull as nearly straight as possible; a resistance coil is in series with the magnet so that the magnet does not get the full potential of 110 volts. String is used from the armature to the spigot of the gas stove.

Attachment plugs are used from the relay board to the magnet board with flexible cord.

The spark coil can be of a Ford type, although a one-inch radio spark coil is used with better results.

Care should be taken to keep the positive wires about two inches from any ground, except at burner, where they are one-quarter inch

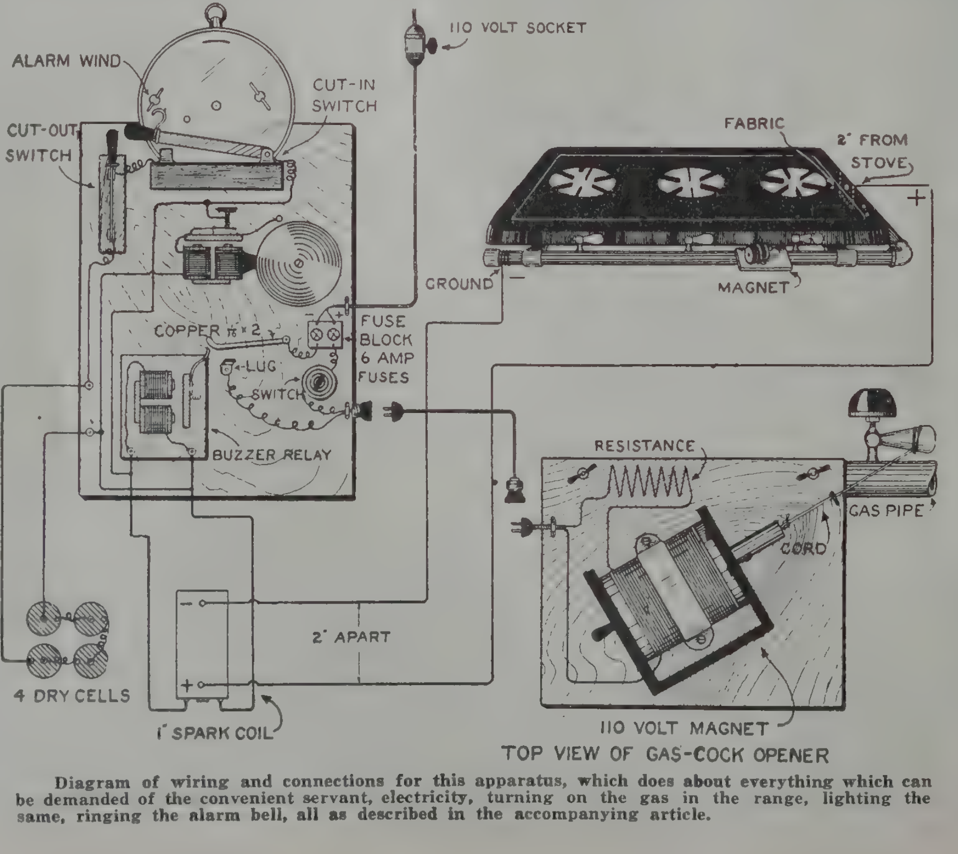


Diagram of wiring and connections for this apparatus, which does about everything which can be demanded of the convenient servant, electricity, turning on the gas in the range, lighting the same, ringing the alarm bell, all as described in the accompanying article.

apart. A piece of fibre is used to hold the wires from the stove.

Clamps that hold the magnet board on the stove feed-pipe are bent to fit the pipe and tapped on top with thumb screws to hold the board in place.

Four dry batteries are used for the bell, relay, and spark coil.

The relay can be used to cut in an electric heater or electric stove. In that case the magnet is not necessary, but if a heater or electric stove is to be turned on by the relay, care should be taken that the arm on the relay makes a good contact, otherwise there will be local heating at that point. Fuses also will have to be replaced according to the load to be used. These devices when wired as shown, give good results. Wind the clock, set the alarm as on any other alarm clock, close the cut-out switch and adjust the setting of the cut-in switch; then put the coffee or whatever there is to be heated on the stove and go to bed, and rest assured the clock will do the rest.

When the alarm goes off pull the cut-out switch, the relay will cut out the magnet on the 110-volt circuit and well—that's all—just get dressed and coffee is ready.

This outfit is useful in many ways.

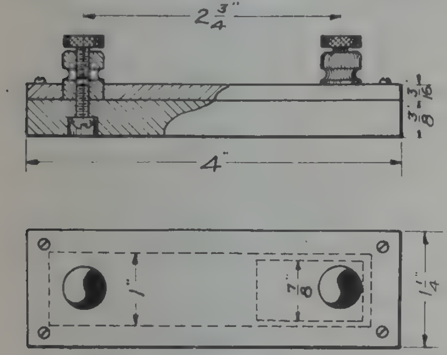
Take a small manufacturer that has one motor running machinery that stops at 12 o'clock for lunch. Instead of having to watch the clock, and stop the machinery, the alarm bell can be a large one on the wall, the magnet on the gas-stove can be the starter magnet. When the bell starts ringing the machinery stops; of course the arm on the starter will swing to "off" position when the relay breaks the magnet coil circuit. In this case the spark coil is omitted.

Once again, the arm on the relay that makes and breaks will have to make a good contact, and also to make and break on the ground side of the 110-volt line. The making of good contacts is most important.

Voltmeter Multipliers

By Frank W. Godsey, Jr.

THE radio and electrical enthusiast often finds himself in difficulties when measuring high voltages. The usual apparatus found in the laboratory is not sufficient to measure voltages of over 75 or 100 units, yet there are continual instances in which an accurate voltmeter is needed which will measure as high as 500 or 1,000 volts without danger to apparatus. The following described multipliers and the simple high voltage voltmeter are easily and cheaply built, and will prove their value many times.



A high resistance element to be used in connection with a voltmeter of relatively low resistance, so as to have the effect of multiplying its indications and making it effective for very high voltages.

The most common D. C. voltmeter reads from zero to 25 volts. This is suitable only for taking readings from low voltage batteries and generators. To be used for higher voltages, a high-resistance coil must be obtained. These coils are usually rather expensive, and are difficult to obtain except for the best known makes of meters.

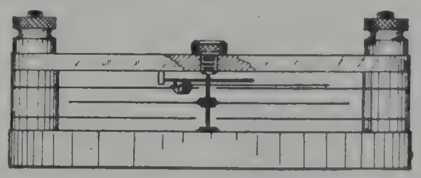
To make such a resistance of wire would involve much time in addition to the great amount of resistance wire necessary. Having encountered this difficulty, I devised the following plans for high-resistances for voltmeter work and met with fair success.

A block of bakelite or hard rubber of about twice the lineal dimensions as in the illustration is secured and a thinner block of the same material is cut to fit on top of it. Both blocks are drilled about five-eighths inch from each end with a drill of a size sufficient to pass the screw in the base of a binding-post. The top or thin plate may be further drilled out so that the base of the binding-post rests on the thick block, if desired; and a hole is drilled and tapped in each corner of both blocks to fasten the top plate down by small screws. The heads of the screws holding the binding-posts are counter-sunk in the bottom of the block so that it will rest on the table in a level position.

A strip of blotting paper or heavy cloth about seven-eighths inch wide is stretched between the two binding-posts on the base of the resistance block. Washers of copper-foil or brass are placed under the binding posts to insure good contact with the resistance strip, which is next thoroughly impregnated with India ink (a carbon suspension ink), and is allowed to dry. It will be found to be rather brittle and should be handled carefully to avoid cracking the deposit of carbon.

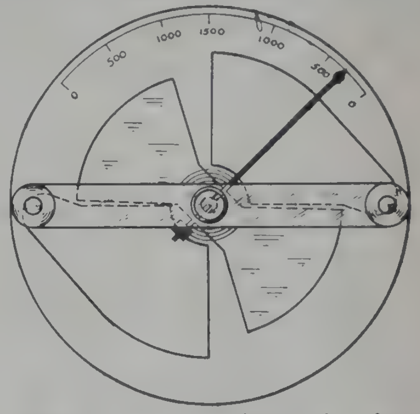
The binding-posts are connected in series with the voltmeter and a known source of current. The deflection on the scale of the voltmeter should be very small for the maximum voltage which it was originally intended to carry. If the meter originally read from zero to 25 and a scale from zero to 250 is desired, the pointer should stop at 2.5 volts. It will in all probability fall short of this mark the first time. If so, disconnect the circuit and ink the resistance strip again, allowing the ink to stand in puddles on it until dry. This should bring the scale up very near the desired mark and a strip of copper-foil or brass may also be inserted under one of the binding-posts and allowed to extend out on the resistance, shortening it until the scale on the meter reads as desired. When the correct adjustment has been made, the excess copper-foil is cut off and the top plate is screwed down.

In case the resistance is too small, narrow strips of the impregnated cloth may be cut from each side until the desired value is obtained. In reading the scale on the meter just described, direct readings are taken and multiplied by ten. The resistance is now ready for almost unlimited service. However, it would be inadvisable to measure voltages over 250 or 300 with a voltmeter having a scale lower than zero to 50.



View partly in vertical section of a simply constructed electrostatic voltmeter of high effectiveness which can be used with the high resistance element described here.

For voltages of 350 or above, the following type of voltmeter is to be recommended: Two sets of stationary plates are fastened to the base with the plates spaced about a half inch apart. To each set of plates, a binding-post is connected. These are the terminals to which the source of power is connected. The rotating vane which swings between the stationary plates and controls the pointer is balanced by means of a threaded weight on a screw fastened directly opposite the pointer. The hair-spring is of varying tension for different voltages. One taken out of a clock can be made to serve very well. The plates and vane should be of aluminum, and the case, in which the instrument is to be kept, should be airtight to secure exact readings in very damp weather.



Looking down on the electrostatic voltmeter, showing the general layout thereof. It will be seen that it passes no current, but operates by the electrostatic attraction of the two oppositely excited segments.

When the current is applied, the moving vane, which has no direct electrical connection and is preferably suspended on jewel bearings, is drawn in between the two sets of stationary plates at each end by the electro-static induction. The tension of the spring is adjusted to the most favorable condition and a known source of current is applied. A mark is made on the extreme part of the scale reached by the pointer, and the distance back to the zero position is calibrated directly in respect to the voltage applied. A meter of this kind can be built which will read up to 200,000 volts, although a very much greater size is necessary for high than for low voltages. This type of meter has the same scale for A. C. as for D. C. volts.

The resistance element here described may have numerous applications in experimental work, because it can be made of very high value and will cost nothing. There are many occasions where it may be very useful to be able to extemporize a high resistance in so small a compass and at such short notice without having to look for special wire, for one can always find a little India ink. Another modification where less resistance is needed might depend on the use of bronze powder suspended in gum arabic solution instead of the India ink. Quite an interesting line of experimentation in the way of the simple production of high resistances, is suggested by this interesting article.

Photo-Electric Telephony

By Dr. Alfred Gradenwitz

Berlin Correspondent Practical Electrics

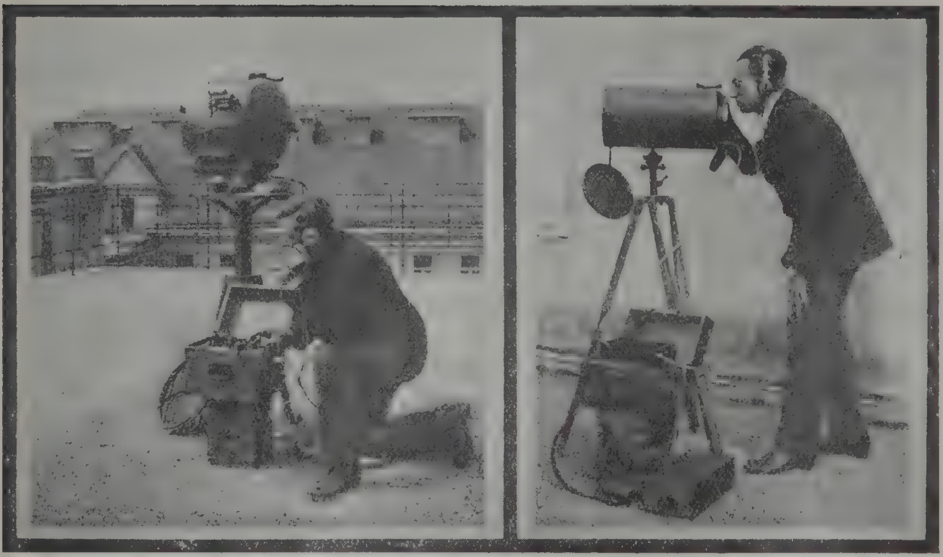


Photo-electric telephone system operating by light-rays and giving telephonic transmission and reproduction of the voice. The right-hand illustration shows the inventor receiving a message.

THE problem of confining the transmission of waves in radio telephony to one given direction and thus eliminating any risk of interference, has been made remarkably easy. The substitution of light waves for those of electricity, with some measure of success, was accomplished about twenty years ago, *i.e.*, long before wireless telephony proper had even been dreamt of.

Ernest Ruhmer, in the first years of this century, made remarkable experiments with an outfit comprising at the transmitting end a "speaking arc," *i.e.*, an electric arc undergoing fluctuations of intensity in accordance with the fluctuations of microphone currents; at the receiving station was a selenium cell, viz., an organ sensitive to variations of light and converting these into variable electric currents perceived in a telephone receiver.

After being temporarily abandoned on account of excessive costs and insufficient efficiency, photo-electric telephony has lately been taken up again, the use of amplifier tubes in the receiver now securing very much more satisfactory results to be obtained than with those early experiments. While the dimensions of the transmitting and receiving mirrors can thus be reduced and the range of transmission increased, the amplification of telephone currents, because of disturbing noises, could not be raised beyond an upper limit. Moreover, the selenium cell, by some sort of inertia, would work too slowly to insure a distinct transmission and reproduction of speech.

These drawbacks have been eliminated by Dr. H. Thirring, Professor of physics at the University of Vienna, whose selenium cells, used in connection with amplifier tubes, are free from any inertia, instantaneously following any fluctuations of light. Moreover, while the active surface of ordinary selenium cells covers a few square centimeters, and accordingly, cannot be placed accurately in the focus of the transmitting mirror, that of the new cells is only about one square millimeter. Finally, their conductivity is much higher than that of ordinary cells, which in turn, makes for greater efficiency.

Each of Dr. Thirring's selenium cells consists of two sets of thin sheet metal electrodes fitting comb-fashion into one another and insulated from each other by mica plates. This double set, constituting as it were a mica condenser, is ground and polished on edge and a circular selenium coating about one millimeter in diameter and 0.01 millimeter in thickness is applied.

The receiver designed by Dr. Thirring comprises an optical part, viz., the receiving camera which, in its focal plane, carries the selenium cell; and an electrical part, viz., the amplifier and the anode and heating batteries as well as a pair of head telephones. A sheet metal funnel containing a simple plane-convex lens eleven inches in diameter and twelve inches in focus is used as receiving camera, the selenium cell being so arranged at its back as to be readily shifted in a vertical as well as a horizontal direction. A small window and a mirror enable the beams of light coming from the transmitter to be concentrated on the selenium, where an inverted picture of the surrounding scenery appears. As regards amplification, a four-valve amplifier with adjustable ratio of transformation has been found best to answer the purpose.

The transmitter comprises either a "speaking" arc or an incandescent lamp searchlight fluctuating under the action of microphone currents. The type with loosely arranged carbon grains of fair size was eventually found to be the most suitable microphone.

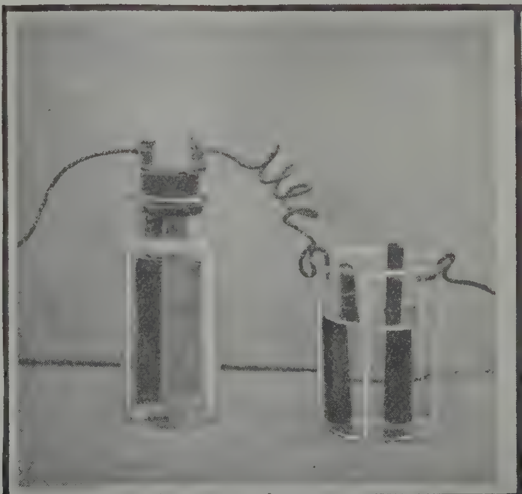
Excellent results have been obtained in bright weather with this outfit over distances of three-quarter miles, a satisfactory communication being even insured during slight rain. The working of the apparatus was found to be quite reliable up to five miles distance, while in connection with one particular test, part of the words could be understood up to 7¼ miles distance. However, these results will be exceeded considerably by the contemplated adoption of an additional amplifier (at the transmitting end).

Demonstration Chemical Rectifier

By Raymond B. Wailes

A CHEMICAL rectifier which will actually and simply show the effects of rectification upon alternating current can be assembled by the electrical experimenter in a short while. Although comprising only a single cell, the rectification is extremely good; the halved or rectified current obtained from it may be used to demonstrate some simple electrolytic experiments.

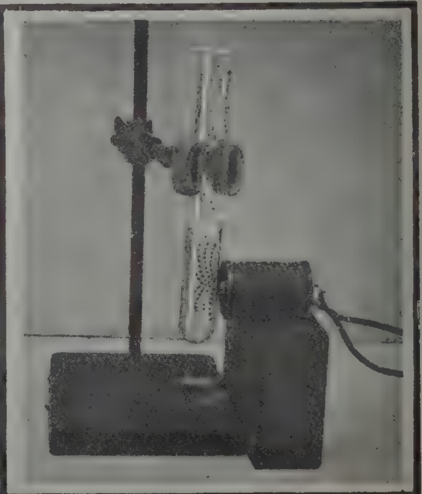
The cell is constructed from a wide mouthed bottle of about eight-ounce capacity. The cork for this bottle serves to hold two plate electrodes, one of lead and one of aluminum. The electrodes should be as long as the interior of the bottle, and as wide as the mouth of the bottle. They can be cut as shown, and the lugs thrust through the cork stopper through slits cut with a small blade of a pen knife. Binding posts connected to the lugs through holes punched through the same with a small nail, make the connection of the cell into the 110-volt alternating current circuit easy. The electrolyte or solution consists of sodium phosphate



Simple apparatus for illustrating theory of an electrolytic rectifier using carbon electrodes, and a solution whose color is affected at one or the other of the plates.

Magnetic Fields Made Permanent

By Raymond B. Wailes



A test tube half full of viscous liquid has finely divided iron suspended within it to be affected by the magnet.

dissolved in water. A pound of this chemical can be purchased for about twenty-five cents at a drug store.

If two carbon electrodes are connected with the 110-volt alternating current circuit and the carbons dipped into a solution of potassium iodide made by dissolving potassium iodide crystals in water, a dark brown discoloration will take place about each electrode, for each electrode becomes positive and then negative many times a second. The brown cloud is iodine, the same substance which, when dissolved in alcohol with a bit of potassium iodide crystals, makes the well known household tincture of iodine.

Now if the electrolytic rectifier is connected in series with the carbon electrodes and the source of current, and the electrodes are immersed in a fresh solution of potassium iodide, the dark brown clouds of iodine will be seen to be coming from the positive electrode only, showing that the little rectifier has really cut the current in half, or converted the 110-volt A. C. into direct current. It is of the intermittent type.

Another simple experiment to show that the current really has been transformed, is to connect a lamp with the 110-volt A. C. line and to place one of the wires over and parallel with the needle of a small compass. The needle will not be deflected. If the single cell rectifier is now placed in the circuit, the lamp will light rather dimly, but any one wire now held over and parallel with the needle of a compass will cause a deflection of the needle, again showing that direct current has been obtained from the alternating.

Other chemical salts can be used instead of sodium phosphate. Sodium bicarbonate (baking soda), ammonium phosphate or bicarbonate, potassium aluminum sulphate or potash alum, answer the purposes of the demonstration.

Many interesting articles clearly describing the theory of the rectifier have been described in past issues of PRACTICAL ELECTRICS.

AMONG the first experiments in electricity which we remember having performed is the visualization of a magnetic field created electricity. Iron dust, we may call it, obtained from the catch-pan of a grindstone was perhaps sought as a source of the "filings," and a magnet, perhaps two, taken from an old doorbell the source of the flux or magnetic field.

Quite a few of us have scattered iron filings over blue print paper, held an electromagnet or pair of permanent magnets beneath the paper, in the first case turning on the current, and at the same time exposing the paper to the sun. Upon immersing the paper in running water a picture of the magnetic field was secured.

A test tube, or even a bottle containing paraffin shavings melted into the liquid form in which iron filings have been shaken, serve admirably as a means of permanently recording a part of the magnetic flux from an electromagnet. Upon allowing the tube of liquid paraffin to cool it will harden, thus holding the iron filings which have been shaken up in the tube, in the place in which they were held when exposed to the field from the magnet. Those at the surface will be visible on the sides of the tube. It is best to sift out the iron dust which is usually found in the iron filings.

A test tube half full of a thick oil commonly sold as Nujol, or other medicinal petrolatum, has a viscosity which almost enables iron filings to be suspended in it. The filings slowly settle to the bottom of the tube, but if a magnet be held at the side of the tube they will be attracted by it and remain suspended in the oil from one wall of the tube to the opposite wall. A denser field can be visualized with this thick colorless mineral oil than if the magnet or magnets were simply inserted in a heap of the filings, for the oil supports the filings and allows the field to arrange them in their characteristic shapes. A gap of air will not give any support to filings in the field of attraction.

Simple Capacity Bridge

By A. Giolitto

A SIMPLIFIED form of capacity bridge for measuring the capacities of condensers is described in the following article:

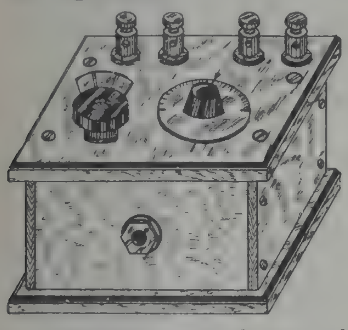


Fig. 1. Mounting of transformer and condensers with a jack switch for use on bridge.

By studying the wiring diagram (Figure 3) its principle of operation will be readily seen. The terminals (A) connect to a high frequency current supply, while the terminals marked (X) are connected to the condenser of which it is desired to measure the capacity. This arrangement places the coil (L_2) in series with the condenser of unknown capacity, while the coil (L_1) is in series with a variable condenser of known capacities.

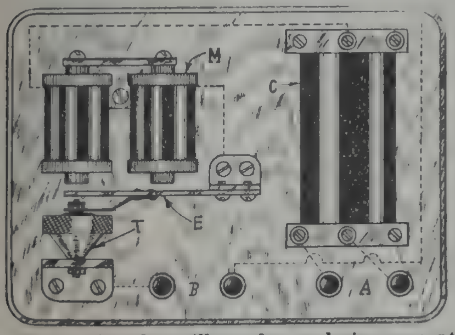


Fig. 2. Simple oscillator for producing current of sufficient frequency for operating bridge. Armature of a magnet is fastened to a transmitter button.

Thus, when the variable condenser is adjusted so as to have a capacity equal to the unknown capacity, the currents flowing through the coils (L_1) and (L_2) are equal. Each of these coils contains the same number of turns and the currents flowing through them are in opposite directions; then their magnetic fields neutralize each other, and the result is that no current is induced in coil (L_3): when this condition exists it is indicated by silence in the telephone receivers (P). However, in practice, as it is quite difficult to produce two coils which have exactly the same number of turns, a slight sound will always be heard in the receivers. Consequently in operating the bridge the variable condensers should be adjusted until a minimum sound is heard.

As will be noted from the diagram, a number of fixed condensers, whose combined capacities can be varied by means of the parallel switch (S), are connected across the regular condenser (C). This greatly increases the range of the bridge. The coils (L_1) and (L_2) compose the primary winding of a push-pull transformer, of which the coil (L_3) is the secondary winding. These transformers are used in radio work, and can be obtained in any radio store. If desired the condensers and transformer may be mounted in a wooden box. Figure 1 shows the appearance of such an arrangement with a jack provided for the telephones.

We will now direct our attention to the construction of a simple oscillator for producing a current of sufficient frequency for operating the bridge. Figure 2 shows such an apparatus.

It comprises a pair of electro-magnets (M), mounted directly behind the armature (E). The armature is fastened to a Skinderviken or N. S. transmitter button (T), which is fastened to the wooden base as shown.

An induction coil (C), mounted on the same base, connects to the magnets and binding posts (B) and (A) as indicated by the dotted lines in the illustration. The electro-magnet (M) should have a resistance of at least 75 ohms. The binding posts (B) are connected to a six-volt battery, and the binding posts marked (A) connect to the binding posts marked (A) on the bridge diagram, Figure 3.

This action will be repeated as long as the battery lasts. The frequency of the current produced will depend upon the natural vibration frequency of the armature. If a tuning fork having a natural frequency of vibration of 1,000 is used excellent results will be obtained.

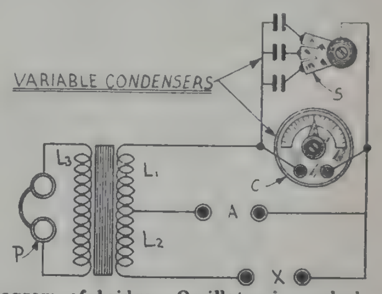


Diagram of bridge. Oscillator is worked without contacts by means of the telephone button.

A vacuum tube oscillator can be used.

The primary of a second transformer (T_2) is connected in the plate circuit. The output of the tube is taken from the secondary of this transformer. A hard tube should be used in this circuit and the voltage of the (B) battery should be around 100 volts.

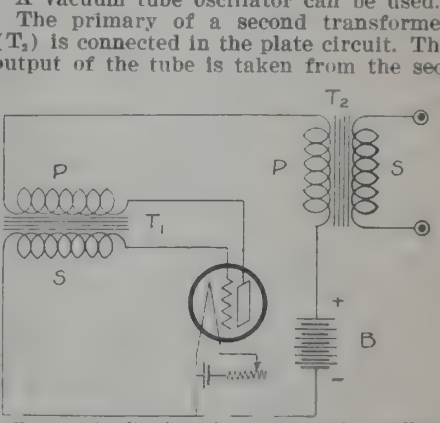


Fig. 4. Application of a vacuum tube oscillator for giving the requisite frequency to the current.

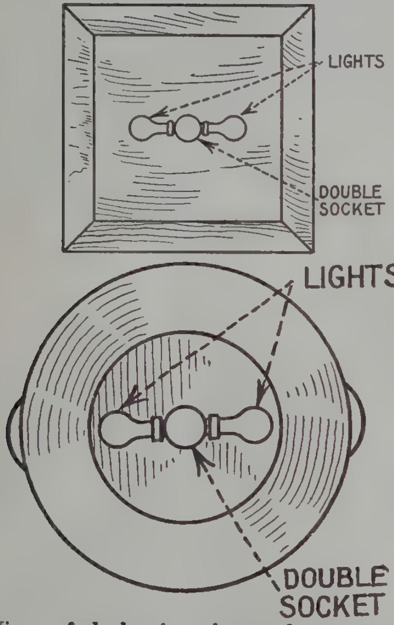
In some cases it might be necessary to insert a (C) battery in the grid lead.

Photographer's Lighting Set

By Godfrey F. Mayor

THE first problem that will be found in the use of electric lights to make portraits is the ability to get enough light and at the same time to keep from blowing a fuse out. Short exposures can only be obtained where a great light is available. The regular house circuits are built to carry 600 watts and can be pushed to carry 700 to 750 when the current is not on for any great length of time.

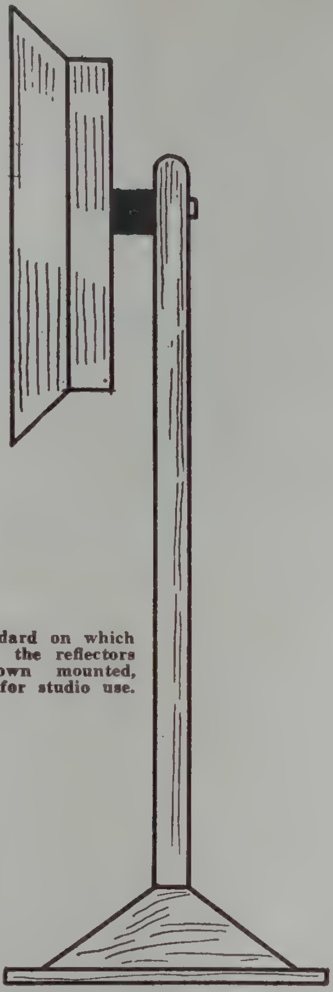
With a good lens and a fast plate or fast film enough light can be obtained from 700 to 800 watts to exact an exposure of only 50 seconds maximum, and this extreme is only necessary when lights are at a great distance from the subject. In order to safeguard against blowing out a fuse and also to better control the lights a switchboard should be first built.



Views of duplex incandescent lamp with two types of reflectors for photographic uses; one reflector is a simple tin pan.

The switchboard shown here is 18 by 24 inches, built on a frame made of 1 inch by 2 inch strips. On the front surface area of the board proper there are three sockets to receive the plugs for the flexible cords of the lights and three switches which control these sockets. Both the switches and sockets can be purchased from almost any five and ten cent store.

The back of the switchboard shown above contains a fuse box. An 18-foot wire which, when not in use, hangs on a hook is used to connect the switchboard to the regular lighting circuit. The fuse box is used so that the danger of blowing out a house fuse is reduced. There are two receptacles on the board to hold extra fuses so that if a fuse is blown out there is always a new one on hand. The wiring of the board can be seen above on left. It will be noted that the negative and positive wires never come in closer proximity to each other than several inches, thus avoiding any danger of a crossed circuit. The wire used should be of the light flexible insulated variety, which is sold at five and ten cent stores for five cents a foot. About five feet of wire will be required to make all the connections in the switchboard. This should give the reader a good idea of the construction and operation of the switchboard.

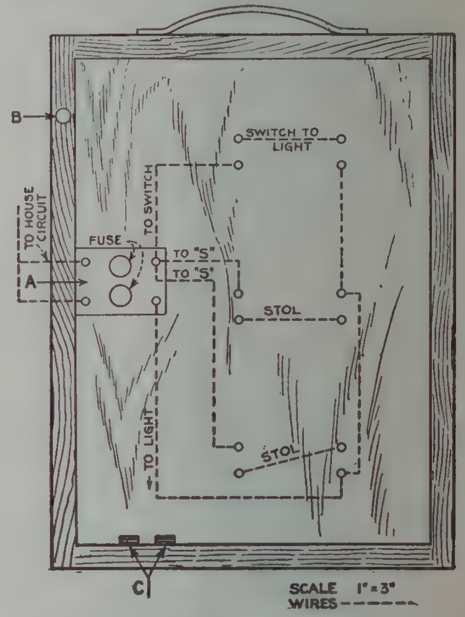


Standard on which one of the reflectors is shown mounted, ready for studio use.

The reflectors may be of several different types, three of which will be discussed here. The writer had several old style postal card projectors which were of no use. The rear compartments of these were removed, leaving an opening through which the light could come. The lenses of the projectors were taken out and in the opening left was placed a piece of white glazed cardboard. The writer also uses an old reading lamp, with a very small cone-shape reflector on it, which is used as a spotlight and gives wonderful results.

Photograph of the back of the switchboard, giving a general idea of how the wires and fuses are disposed, and showing the connections to the lighting circuit.

For those who have no old postal card projector the reflectors shown on the left hand will serve as well. The reflector on the stand is made of wood. The lumber used should be light in order that the box can be easily handled. The box proper should be from 18 to 24 inches square. A frame of 1 inch by 2 inch wood should first be made. The back of this frame is then covered with ceiling board, the smooth side being on the inside of the box. On the framework and facing out there should be a flaring frame of lumber 6 inches wide, or a piece of beaver board of the same width, set at an angle of 30 degrees.



Front view of the switchboard with dotted lines indicating the wires; their inscriptions give clearly the course of the conductors.

A lamp socket is placed in the center of the reflector and the inside of the box is covered with tinfoil or painted with a white finishing paint. As two lights are the best to use, a double socket should be purchased and this is placed in the socket of the reflector and the lamps are to be placed in this double socket. The wires for the current are run through from the rear; a length of wire of 15 to 20 feet is suggested. The use of the stand, as shown, is not absolutely necessary, but such a support is a great aid. The stand is built out of metal or wood or a regular tripod can be used.

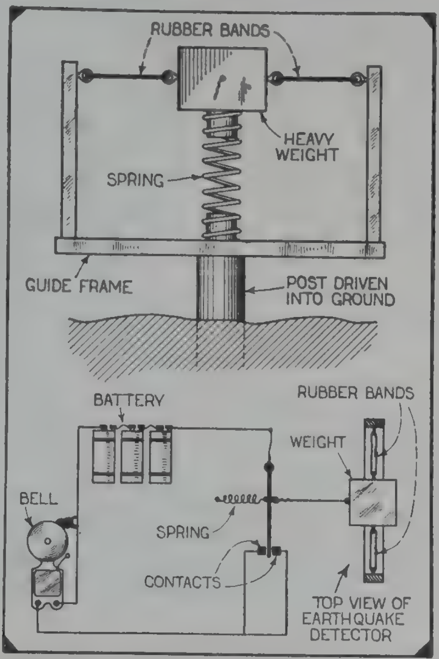
The round reflector shown above is made out of a cheap tin pan. This reflector is much easier to make than the wooden one. The pan should be about 15 inches in diameter and about 4 inches deep. A pan of a bit larger diameter can be used, but the diameter should not be too large because of the pan being too cumbersome. The center hole should be a little smaller than the size of the socket to be used, which should be one of the ceiling variety. In order to make it easy to attach this reflector to the support a small piece of wood, an inch larger than the opening cut in the pan, is fastened on the back of the pan and the lamp socket inserted from the front. A piece of cardboard or some suitable material is placed between the metal pan and the socket to prevent a short circuit.

This completes the equipment any amateur would need in making portraits. As to the best arrangement for setting up the lights, it would be impossible to give anything definite. This must be determined by the photographer at the time of taking the picture. The writer suggests that the switchboard always be near the camera and that the spotlight be used below the camera. The reason for this is because of the need of concentrated light in the front. There are times, however, when this is not the case, so the user of the equipment must judge the best position of the lights. The reflectors, in most cases, should be used on the side and it is not always necessary to use both reflectors. The photographer should use his own judgment in the use of the lamps, both as to number and positions.

Finally, there is a word to be said about the kind of electric bulbs to use. The 250-watt flood light is probably the best of all that can be obtained.

Investigation

By Esten Moen



Miniature seismograph which rings a bell on the least quiver. This is an excellent scientific toy and is warmly commended to our readers. We are sure they will enjoy the vivid description of this and of the rest of Mr. Moen's ingenious apparatus.

WHEN you were knee-high to a grasshopper, you were more busy at work investigating than you are today. Sure you was. So was everyone.

Remember when you busted up a dry cell to find the "power plant"? Wound your first electromagnet with *bare* copper wire. B. & S. Gauge No. 24? Stuck a screwdriver into a socket? Continually forgot the number of amperes there were in a volt?

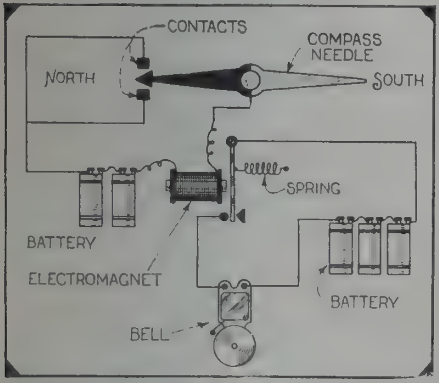
Today, of course, you continue experimenting, but perhaps not with the fever heat of those days.

Now fellows, a real, professional, investigator's laboratory ain't complete without an earthquake alarm. Should say not. Why, it's a connection with the world!

Figure 1 will tell you the agonies necessary to make it. Y' understand, when the volcanoes explode, it shakes the earth; the earth rattles your sensitive detector; makes the bell ring; and all you have to do, is to watch the papers, to tell you where the volcano was.

Now, then, you said supposin' they was no volcano, did it? Might have been a nearby freight train or, er—— pardon me, I fear you ain't interested in such?

Ye ever heard tell o' th' North Pole? Cold as th' blazes up there, and they do say, all compasses point that-a-way.



Apparatus for giving an alarm on sudden deflection of the compass needle, so as to prognosticate a storm, provided the storm is obliging enough to deflect the needle.

Come to think of it—one afternoon in winter, coupla years ago, I was lookin' at my compass quite casually. And I'll be horn-swoggled and dum-goozled if the dern dinkus wasn't oskillatin' back and forth. And soon after, we had a storm!

Now, my dear, let's look at Figure 2. See the main part—it's a switch, detector and relay combined. If the North Pole oscillates, the compass swings and rings your bell—and you can bet your boots, you will soon have a storm.

Now, we've studied, let's see—vibration and magnetism, eh? Is there—oh yes, we forgot about static. The pest and disturber of our peace. What'll we do now?

Let's see—the encyclopedia mentions that there's a difference in voltage, between the clouds and the ground. So many volts per foot, I think. Also, that a rain is preceded by high voltage between the clouds and earth. Who can tell—maybe the high voltage attracts the clouds? Anyway, the clouds come.

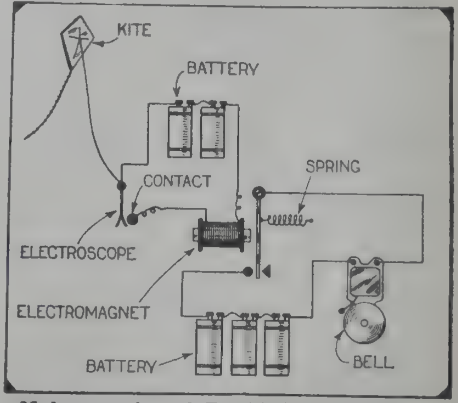
If static increases before a rain, it stands to reason that we can predict a rain!

Benjamin Franklin showed that the best way to bring down static is to use a kite. Be warned, my dear, kites attract lightning. And a bolt of lightning is goodbye in any language!

You know, there's a thing we call, an electroscope. It detects the presence of static. Two very thin metal leafs, hang, face to face. They separate (are repelled from each other) when static is put into them.

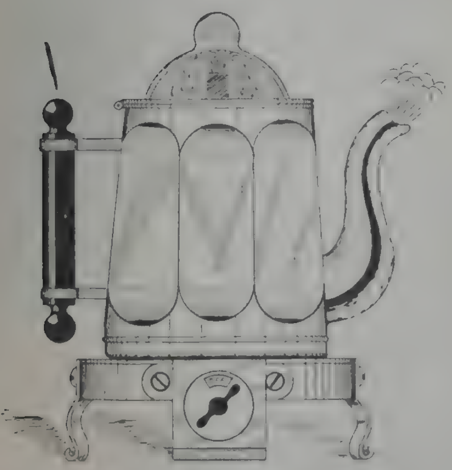
Figure 3 shows what I mean. The increased static moves the leaf sufficiently to touch a contact point. When this happens, a sensitive relay circuit is closed, rings a bell, and you know for sure that rain will come!

How do you keep the kite up all day—excuse me, I have a call on the other phone.



Modern version of Franklin's kite experiment. An alarm is rung when the kite becomes charged with static electricity.

Electric Percolator



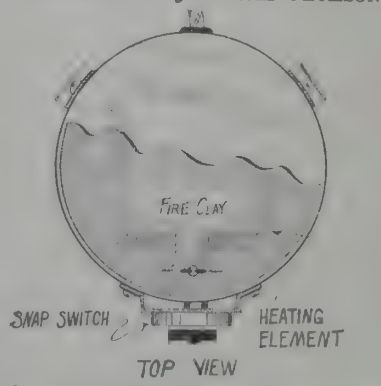
An everyday coffee percolator mounted on a home-made electric heater.

IN making the electric percolator shown, an ordinary coffee percolator is used.

The heater is a little larger than the bottom of the percolator and one inch deep. Heavy sheet iron is used for the body and legs. The body, shaped like a pan, is partly filled with fire clay into which the heating element is pressed; however, the coil of fine resistance wire should be pushed down into the clay only far enough to hold it in place.

One of the legs of special shape supports a snap switch which controls the heat. Two smaller legs are placed as shown in the top view. The flexible cord enters at the back and runs along under the heater to the switch. The lead-in wires enter through a small hole in the bottom as shown, to which the heating wire is connected. As solder cannot be used at this point the connection should be carefully made. The top is made of a piece of sheet iron. The heating element consists of ten feet of No. 26 heating wire wound into a long coil and bent into an open square.

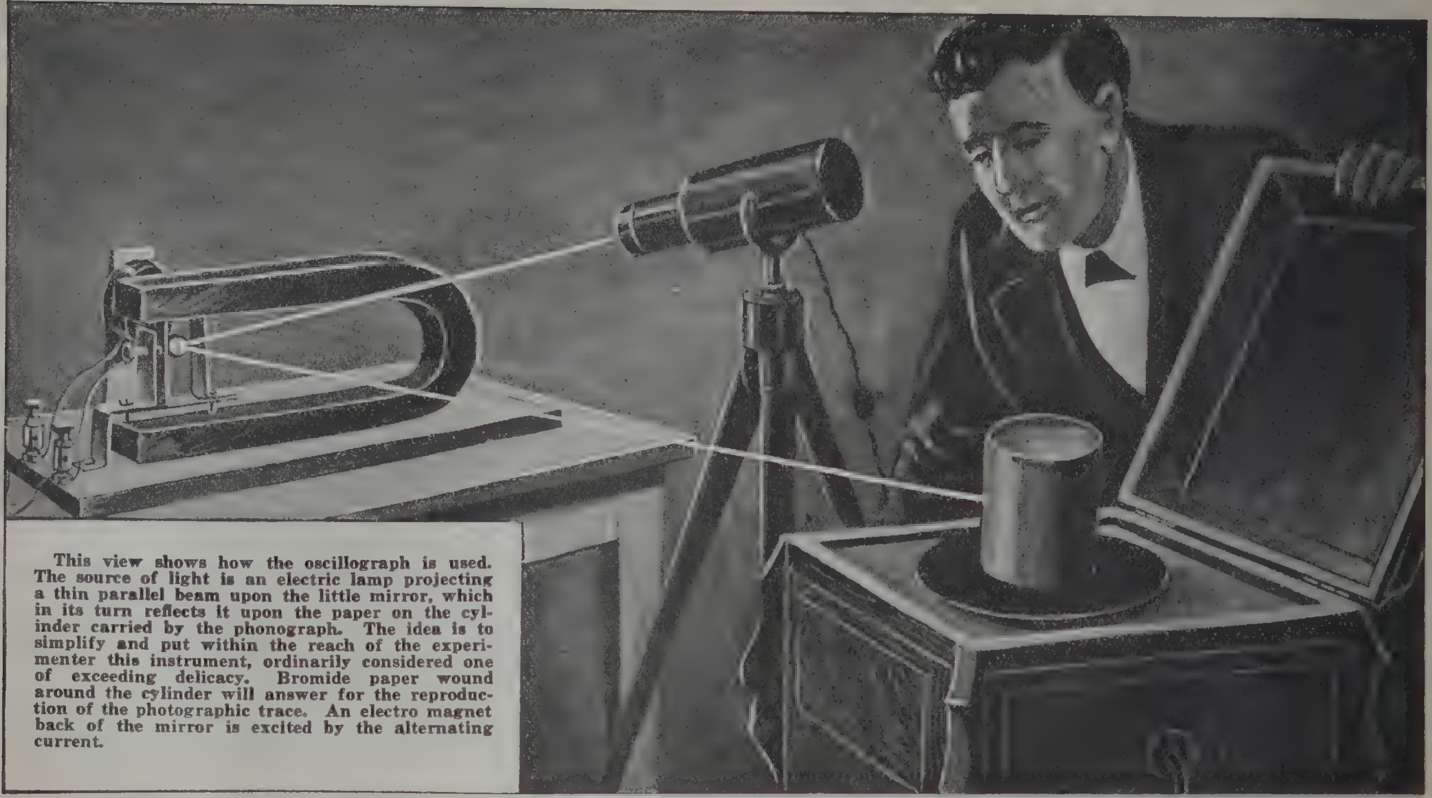
Contributed by HAROLD JACKSON.



The home-made electric heater, showing heating coils and connections.

Simple Oscillograph

By Carter Fiske



This view shows how the oscillograph is used. The source of light is an electric lamp projecting a thin parallel beam upon the little mirror, which in its turn reflects it upon the paper on the cylinder carried by the phonograph. The idea is to simplify and put within the reach of the experimenter this instrument, ordinarily considered one of exceeding delicacy. Bromide paper wound around the cylinder will answer for the reproduction of the photographic trace. An electro magnet back of the mirror is excited by the alternating current.

MANY amateur electrical experimenters will be interested in constructing a simple oscillograph which will accomplish many of the things done by large expensive machines in photographing the action of various currents. By the use of the oscillograph the experimenter is enabled to visualize the behavior of an alternating current under various conditions, and a few days of experimentation will initiate a liberal education in alternating current phenomena.

The requirements for the oscillograph described in this article will be found in every electrical laboratory, however modest. There are no elaborate or expensive parts. The first thing needed will be an old horseshoe magnet, which should have some strength left in it. It does not have to possess its original power. Aside from this a couple of binding posts and a few ounces of No. 22 single cotton-covered wire, a baseboard and a few bits of brass will be required. The base can be of any good quality wood and the two binding posts should first be mounted upon one end of it as illustrated in the photograph.

Then a little clamping piece or strap is made to hold the magnet permanently to the base. This done, everything is ready to construct the sensitive element.

At this point it would be well to consult the illustration of this particular portion of the instrument. It will be seen that two thin brass supports are made to carry the moving element, which is made up of a shaft carrying a bar of soft iron, which may be a bit of wire, and a tiny mirror. The shaft is made of a small piece of brass wire, which should be carefully pointed at each end. The points should be sharp but not needle-like; a point on the order of that of a marking punch should be made.

It will further be seen from the drawing that the thin brass strips, which are used as bearing supports, are bent at right angles near the ends and provided with two small indentations at the point where the bearings are located. It is best that these indentations be made with some accurately sharp-pointed instrument, such as a center-punch. Another small angle-piece is secured near one of the bearings and provided with a machine screw for adjustment purposes. It will be seen that tightening this machine screw will determine the degree of friction on the bearing.

The construction of the moving element of the oscillograph is started by attaching the small piece of soft iron wire at right angles to the shaft with the sharp-pointed ends previously made. Soldering will answer for the attaching. When this job is finished a small light mirror will have to be produced, and since it is impossible to purchase these, the constructor will have to go to the trouble of making one by silvering the surface of a piece of microscope cover glass. This is done by immersing the cover glass in a proper solution and every recipe book will give at least a dozen formulas. The mirror cannot be large, for it might be too heavy and offer so much inertia that the action of the oscillograph will be sluggish. A piece of mirror with an area two or three times greater than that of a pinhead would suffice, so there is no danger of the amateur making one which will be too small. The mirror is held to the shaft and iron wire by means of glue or shellac.

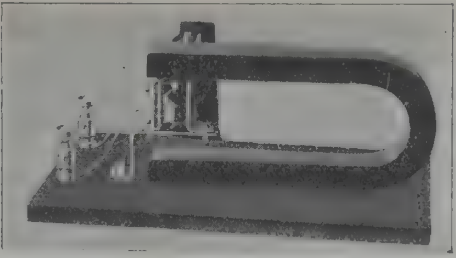
The exciting magnet used in connection with the oscillograph is wound upon a wooden spool of the dimensions shown in the illustration. No. 22 single cotton-covered magnet wire is used, and the leads are brought up to the binding posts on the base of the instrument. The hole in the core of the magnet is filled with soft iron wire, and when the electro-magnet is mounted this core should reach to a place directly back of the soft iron wire carrying the mirror. The wooden support can be used to hold the coil in the proper position. Everything is now ready for the first experiment with the exception of the source of light. This we must arrange by mounting a small six-volt automobile lamp in a small box properly ventilated and with the front provided with a small hole which will allow a very narrow beam of light to escape.

As an initial tryout, the coil of the oscillograph should be attached to the 110-volt lighting circuit in series with a lamp, since it would not be wise to permit this heavy current to surge directly through the coil. When the current passes, the mirror will be found to vibrate in sympathy and synchronism with the alternations if adjusted properly. If it does not vibrate, a little experimenting with the bearings will bring it to a workable condition. Perhaps a drop of some very light oil, such as watchmaker's oil, on the bearing points will prepare it for operation. If the mirror swings too far its movement can be dampened a little by carefully adjusting the bearings with the aid of a machine screw. It must be understood that the average alternating current makes 120 reversals a second and the mirror must be tuned up to the proper point before it can reach this speed. However, with a little practice it will be found very easy to set the mirror so as to respond perfectly. The movement of the mirror must not be too sluggish, and if allowed to swing too far it will be sluggish.

If we darken the room and allow the light beam from the little lamp to fall upon the mirror at an angle and be reflected upon a piece of white paper at a proper distance, we shall notice the spot broaden as the beam vibrates, when an alternating current is sent through the magnet coils. If the mirror is adjusted properly the vibrating beam will be in perfect synchronism with the alternations of the current. If we move the paper at the same time and at a uniform speed the light beam would inscribe a sinuous line similar to that shown.

It is evident that a permanent record of the movement of this light beam could be made if the beam was allowed to fall upon a strip of sensitive photographic paper in regular motion. This can be done by the aid of a phonograph and a tin can with the paper arranged upon it as illustrated. A hole is punched in the bottom of the can to enable it to sit flatly on the phonograph turn-table with the center pin protruding through the hole.

The entire apparatus is set up ready for use and the beam of the oscillograph is projected so that it will strike the revolving paper. During this preliminary test, however, the paper need not be attached to the revolving support, since it would be uselessly exposed. After the focusing is finished, the room is darkened and the sensitive paper put in place. Between the oscillograph and the paper there is placed a piece of cardboard, which will act as a shutter. The current is then permitted to enter the oscillograph and the paper is set in motion. The shutter is lifted for an instant and replaced after the paper has made one complete revolution. The photographic record can then be developed in the ordinary manner.


Reproduction of a photograph of the simple oscillograph, showing the proportions and general layout. It can be made large or small as desired.

Innumerable experiments will suggest themselves to the ingenious builder of this device. For instance, a chemical rectifier can be constructed and connected in series with the oscillograph. The unilateral conductivity exhibited by the rectifier will be indicated on the photographic record left by the light beam. An ordinary vacuum tube can be so arranged, using only two elements, that it will act as a rectifier, and approximately the same effect will be had. The smoothing-out effect of large inductances can also be noticed in the records of the oscillograph as well as the distorting effect of heavy capacities.

$200 Miniature Model Contest!

LAST CALL

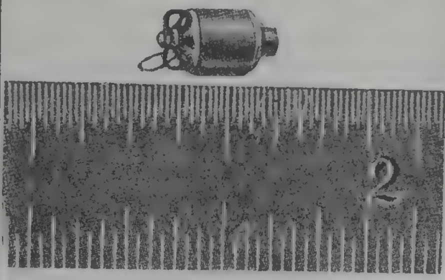
HERE is a brand new contest for the best miniature working models, and we thought it of such importance that we are doubling the customary amount of our prizes by offering $200 in prizes instead of $100. This contest bids fair to be one of the most important in recent years in the United States and the winners will come in for their share of newspaper and magazine publicity throughout the country.

The idea, in short, is to ask our readers to build miniature models of existing electrical appliances. The thing is simple enough, the only difficult part being that the model must be small. By small we mean *real small.* Take, for instance, the motor which we show on this page. As will be noticed, it is only 19/64ths of an inch long and weighs only 5.5 grains. Of course, only a jeweler could make such a small piece of work, although there may be a few mechanics skillful enough to duplicate the model. We shall not be quite so severe with our contestants, and so long as the models are kept down to ¾ inch or less there is a good chance of winning a prize. The ¾ inch dimension would be the model's greatest dimension. If any of the models submitted are smaller than this, so much the better, as they will have a more favorable chance for a prize.

Although we show a miniature motor on this page there is no reason why our readers cannot submit other motors of their own design. The designs *must* and can only be of an *electric* appliance or apparatus actually in use today. A list of suggestions might include the following: Electric motor, dynamo, generator, motor generator, telephone receiver, transmitter, complete working model of a modern desk telephone, a trolley car, an electric locomotive, electric truck, storage battery, switches, telegraph keys, telegraph instruments, heating appliances, radio instruments, etc., etc.

The contest, in other words, aims to reproduce a miniature working model of some existing electrical device. It must not only be a model, *but the model must work.* In other words, should you make a miniature telephone receiver that is about ¾ inch long or less it must actually work. The same holds true of all other entries that are submitted. There are hundreds of electrical appliances, apparatus and instruments of which miniature working models can be made, and it is up to you to choose the best article that appeals to you. It goes without saying that the workmanship of the submitted model must be good. The judges will consider workmanship and the care in the construction.

The Smallest Electric Motor



A motor recently completed by Ivan T. Nedland, a jeweler of North Dakota, weighs only 5.5 grains and is said to be the smallest motor in the world. Its commutator, which measures 0.045 inch in diameter, is made up of four gold segments insulated from each other with mica. No glue or cement was used in its construction. The shaft on which the commutator is mounted is made of steel and is 0.009 inch in diameter. Fiber insulation is used between the commutator and the shaft. The tiny armature, 0.09 inch in diameter, has four pole pieces and is wound with No. 40 silk-covered copper wire. The weight of the revolving part is 1.25 grains. Between the armature and the yoke two field coils are provided. The silver brushes measure 0.012 inch in diameter and are held against the commutator by springs 0.004 inch in diameter. In over-all dimensions the motor measures 19/64ths inch long and 11/64ths inch high. All visible parts are finished in Roman gold. When connected to a small flashlight battery the motor runs at a very high speed.

The models submitted will in all cases remain the property of the builder. The judges will merely examine them for workmanship and satisfy themselves that the models will actually work, the same as their big brothers. Naturally there will be a good deal of work involved in making them, and for that reason they should be sent by registered mail to be certain that they arrive safely. The models will be returned to the contestants after the close of the contest at our own expense. Each entry should be accompanied by a description and, if possible, a working drawing of the model, giving all dimensions and other information. Also a photograph of the contestant is desired. Manuscripts entered in this contest cannot be returned. We reserve the right to publish all worthy photographs and descriptions of models that do not win a prize by paying our regular space rates for such material.

$200 IN PRIZES

First Prize...........	$75 in gold
Second Prize.........	50 in gold
Third Prize..........	20 in gold
Fourth Prize.........	20 in gold
Fifth Prize..........	10 in gold
Sixth Prize..........	10 in gold
Seventh Prize........	5 in gold
Eighth Prize.........	5 in gold
Ninth Prize..........	5 in gold

In publishing the articles all rights revert to the publishers, except ownership of the models themselves, which, as stated above, will be returned to their constructors. Write clearly, use only one side of the paper when writing, using ink or typewriter and double spacing. Manuscripts written in pencil will not be accepted.

Contestants can enter more than one model in this contest, which is freely open to everyone except manufacturers already manufacturing models. Please observe the following rules:

1. Miniature models entered in this contest must not measure more than ¾ inch in any dimension. The smaller the model, the better the chance to win a prize.

2. The miniature model must be in perfect electric working condition. No dummy models can be entered in this contest.

3. Wherever possible, the miniature model should use the same materials as the standard makes now use. For instance, if a telephone receiver is duplicated, it must have a steel magnet, copper insulated wire must be used on the solenoid spool, housing must be of hard rubber or composition. There are some exceptions to this rule. For instance, where molded composition or porcelain is used, the designer may choose other insulating materials such as bakelite, hard rubber, hard wood, and the like.

4. To guard models against burning out due to excessive current, models should be tagged, giving the maximum current or voltage that the models will safely stand. If radio miniature models, such as detectors, vacuum tubes, etc., are submitted, these must, of course, not only work electrically, but must actually work in the radio circuit for which they are intended.

5. All models must be sent completely assembled. The judges cannot take it upon themselves to assemble models.

All prizes will be paid upon publication. This contest will close at noon, March 15, 1924, at which time all entries will have to be received by us in order to qualify. Should two contestants submit the same prize-winning idea, the same prizes will then be paid to both. Address all communications, packages, etc., to *Editor, Miniature Model Contest,* c/o this publication.

Awards in the $50 Special Prize Contest
For Junior Electricians and Electrical Experimenters

First Prize, $25.	Second Prize, $15.	Third Prize, $10.	Honorable Mention.
Elmer L. Berg, 68 Summer St., Plymouth, Mass.	Russell A. Pickens, Jr., 117 Common St., Watertown, Mass.	James Newby, 111 W. 28th St., Indianapolis, Ind.	Robert Rollins, 3561 Lincoln Ave., Oakland, Calif.

First Prize
Insulator Lamp
By Elmer L. Berg

THE illustration shows a table lamp, made out of a 22,000-volt insulator. It is constructed as follows:

Get any discarded high tension insulator, preferably of the "Victor" type, as it has good lines, and drill a ⅜-inch hole through the top center of porcelain; then assemble a pull chain socket, with a canopy, by means of a ⅜ inch to ¼ inch hickey.

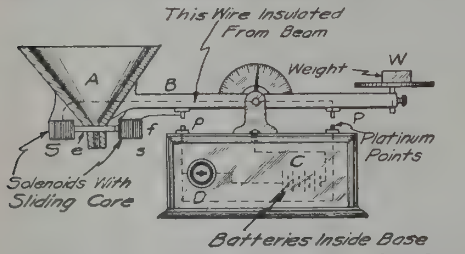
Cut a length of ¼-inch rod long enough to go through the insulator, and through a base of maple or other wood. The rod should be threaded to take a nut. The lamp cord is connected into the socket and is drawn through the same hole with the rod. The base has a hole bored horizontally to take a regular ⅛-inch socket bushing to finish the appearance. The base can be stained to harmonize with the insulator. Any paper or parchment shade which the socket will take can be used as the top of the lamp.

First prize winner, a beautiful standard lamp, using a high potential insulator for its body.

Second Prize
Automatic Electric Scales
By Russell A. Pickens

THE scales consist essentially of a base containing the batteries, a beam with two pans, one the funnel-shaped pan with a trap door, balanced on a fulcrum, two coils with a sliding core and platinum contact points to give contact at the proper time.

The automatic electric scales described below are especially adapted to measuring sugar, grain or other finely divided substances, by weight. The user fills the funnel-shaped container on the left with an excess weight of the article, while on the right he puts the desired weight. The scales in overbalancing make electric contact with the points and in this way one of the solenoids, by means of a sliding core, opens a sort of trap door at the bottom of the funnel-shaped container.



Scales which automatically weigh pulverulent material, such as sugar or flour, capable of quite accurate adjustment and of great rapidity of action.

Sugar is put in the pan (A), in excess, and the pan drops down thereby bringing the points (p) together. This completes the electric circuit which sends a current through solenoid (s). This draws the core (f) toward it thereby opening the trap door (e) which lets the sugar run out. The sugar continues to run out until its weight is a little bit less than that of the weight (W) and then the beam (B) moves up, breaking the contact at point (p) and making it at point (P). This completes another electric circuit which sends a current through the solenoid (S) which draws the core (f) toward it. This closes the trap door (e) shutting off the flow of sugar. This leaves the weight of the sugar slightly less than that of the weight (W), but can be offset by adjusting the scales to take care of this or by adding just enough sugar to balance.

These scales would be a boon to the small store which weighs out sugar to put up in small lots, or on a large scale to the wholesaler who puts it up in larger quantities.

$50 IN PRIZES

A special prize contest for Junior Electricians and Electrical Experimenters will be held each month. There will be three monthly prizes as follows:

First Prize	$25.00 in gold
Second Prize	$15.00 in gold
Third Prize	$10.00 in gold
Total	$50.00 in gold

This department desires particularly to publish new and original ideas on how to make things electrical, new electrical wrinkles and ideas that are of benefit to the user of electricity, be he a householder, business man, or in a factory.

There are dozens of valuable little stunts and ideas that we young men run across every month, and we mean to publish these for the benefit of all electrical experimenters.

If in any way possible, a clear photograph, should be sent with the idea; but if that is not possible, a good sketch will do.

This prize contest is open to everyone. All prizes will be paid upon publication. If two contestants submit the same idea, both will receive the same prize.

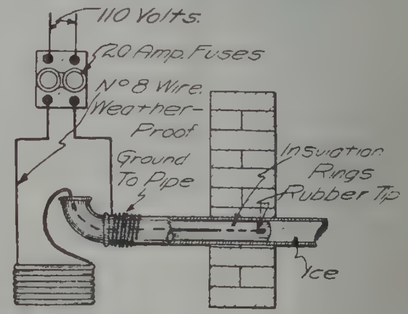
Address *Editor, Electrical Wrinkle Contest,* in care of this publication. Contest closes on the 15th of each month of issue.

Third Prize
Thawing a Water Pipe by Electricity
By James Newby

SOMETIMES a frozen water-pipe is to be thawed out in a place where no primary connection or transformer is available, or where it would be more expense and trouble to set up the transformer equipment than the single thawing job is worth.

In such cases the method to be described would be very useful, although a little more time is required than by the usual scheme. In thawing several ¾-inch service pipes in the winter I used the contents of the pipes themselves as conductors or water rheostats, making the exposed end of a No. 8 weather-proof insulated wire act as one of the electrodes; as shown in Figure 1, several rings of insulation were cut from the wire to expose the copper surface, while a rubber tip was attached to its end, serving to keep the metal from contact with the pipe which was connected to the other side of the line.

Through the water path thus afforded 110 volts forced a current of from 15 amperes to 20 amperes, delivering 1.5 kilowatts to 2.0 kilowatts near the face of the ice plug. In one instance, 16 feet of ice in a ¾-inch pipe were thawed out in four and one-half hours, a boy being left in charge to feed the wire as the ice front retreated. The circuit was protected by a 20-ampere fuse, so that no damage could result from an accidental short-circuit. This length of pipe which was frozen, was, of course, exceptional and was due to several days' delay in calling for assistance.



Simplified method of thawing out a frozen service pipe, attacking it from the cellar of the residence, so as to avoid excavation.

As the water-rheostat method thaws at the rate of three or four feet an hour, only a short time is required to clear the usual foot or so of frozen plug. This scheme is applicable, of course, only to straight lines, but as most service pipes are straight, the method will generally be found effective. The natural slope of the pipe toward the street drains the water toward the point where the heat is produced. If the pipe is quite level, a vertical elbow may be attached at the cellar end. In any case the street valve should be kept ready to be turned off the instant the ice plug melts and the water comes with a rush.

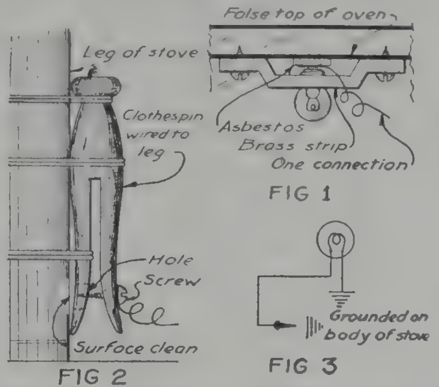
One man can set up the simple apparatus needed to thaw pipes by this method. The expense of a line gang, a transformer wagon and a team and the usual electrical apparatus are all avoided, and the trouble and danger of making primary connections are eliminated. To thaw a 16-foot ice plug above mentioned, eight kilowatt-hours to ten kilowatt-hours were required, costing about one dollar for energy, in addition to which was charged the time of one man. The essential point is that there must be some water in contact with the face of the ice, to be heated by the current.

Honorable Mention

Oven Light

By Robert Rollins

THE mother of an electrical experimenter bug is a long suffering one. She finds her spools, boxes, tins, hairpins, and goodness knows what else "borrowed" in the name of science. Her life is a troubled one. She trips over wires laid temporarily through the house, gets shocks from the door-knobs, and pays the running expenses of electric furnaces and such "current-eaters." She sadly sees her garden ruined when electro-culture of plants is confused with electrocution. She waits calmly in the dark until a fuse is repaired after some unsuccessful experiment, and many other instances prove her a real martyr to science.



Simplified arrangement for lighting interior of an oven, so that baking operations can be watched by the housekeeper.

Here, by what I propose, she loses a clothespin, but willingly. An illuminated oven is the dream of all good cooks, and a measure of safety for those that she cooks for. Even the oven with glass door is so dark inside that guessing is too frequent, and now the experimenting son comes to the aid of the cook.

The lamp employed should be a small one. I used a flashlight globe with one dry cell. Though a larger one may be used, and a transformer substituted for the cell, it may occupy too much room and the small one gives sufficient light. This lamp has been in daily use for nearly five months and the heat of the oven seems to have no effect on it. It has been cleaned of grease several times, but that is of little importance.

A strip of copper, bent as shown and fastened to the false or inside top of the oven holds the lamp. Two small holes were bored in the false top and wood screws of larger dimensions easily held in the soft metal. A bit of asbestos was used as an insulator. A small piece of porcelain or glass will serve as well. A bare end of wire was rolled into a small wad and put between the tip of the plug and the insulator. This is held firmly when the lamp is screwed in and the contact is complete.

The switch enables one to light the lamp when the hands are busy by pressing one foot against a prong of the clothespin, the pin being bound to one leg of the stove. A screw is set in one prong projecting partly through a hole in the other prong. When the prong is pressed in, the screw touches the cleaned surface of the leg of the stove, the metal of which forms a part of the circuit, and the lamp lights. When the foot is removed, the lamp goes out and no current is wasted. The pin should be fastened so that one foot may be conveniently held against it while standing in front of the oven.

Awards in Odd Electrical Experience Contest

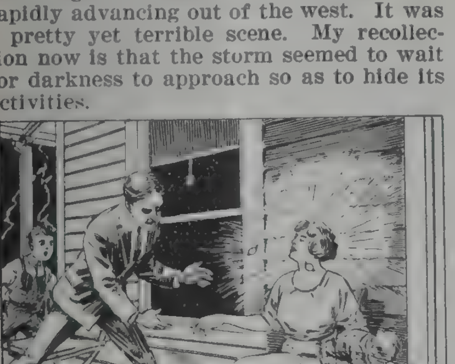
First Prize, $20.	Second Prize, $10.	Third Prize, $5.	Fourth Prize, $2.50.
Emery Abrahamson, 514 Jefferson St., Oconomowoc, Wis.	Clarence H. Mason, 5872 Etzel Ave., St. Louis, Mo.	E. C. Meilloret, 9715 97th Ave., Woodhaven, N. Y.	James McDonald, 3713 Delmar Blvd., St. Louis, Mo.

First Prize

Clean Cut From the Sky

By Emery Abrahamson

ONE summer day about fifteen years ago my mother was sitting on the porch with my brother on her arm. The sky was overhung by a pale yellow light, causing a dreary, gloomy atmosphere, which made the air seem oppressive. The sun had just gone to rest. The lower horizon was overcast by a lowering mass of dark, angry-looking clouds. A storm hung just on the horizon. The pale light soon began to wane and darkness came rapidly advancing out of the west. It was a pretty yet terrible scene. My recollection now is that the storm seemed to wait for darkness to approach so as to hide its activities.



Curious instance of electric discharge, where a person's head was enveloped by a sort of St. Elmo's fire.

The sound of thunder soon reached us. Lightning flashed rapidly back and forth between the threatening clouds. It was a wonderful display of the power above in the air. My mother began to worry lest the storm should become so severe as to force her to retire indoors, as she was wearing glasses. My father assured her that the storms always looked worse than they were and that the storms that summer had never been very severe, although some had threatened to be so.

My mother, thus reassured, remained out of doors to watch the storm approach. It came on rapidly, with promise of not staying long, but with the prospect of being severe while it lasted. The thunder became louder and of a more menacing tone. At last the tempest hit us with a strong wind bowing the trees almost to the point of breaking. The noise was beautiful yet terrible. The storm soon passed by and the danger seemed over for the time being.

We had crowed too soon, however. The sky was suddenly lighted by a flash of lightning so fierce as to make the other flashes seem insignificant. A sudden stillness seemed to hang on with a dangerous aspect for our safety. The air seemed full of apprehension and doubt. What was going to happen next? A sudden report and the air was full of fire, and my mother's head was suddenly enveloped in a halo of burnished light. The noise ceased almost as soon as it commenced. My father, startled out of his wits, sprang up from his chair just in time to catch my mother as she fell forward. My baby brother fell out of her nerveless grasp down upon the porch floor.

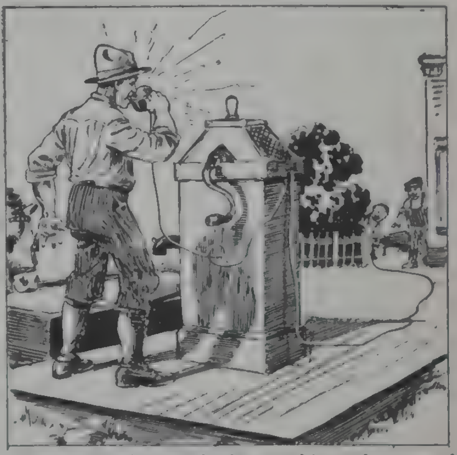
My mother soon revived and found that the flash had cut her glasses just where the lenses are held by the frame. The cut could not have been cleaner if it had been done by a professional cutter of metals. The experience had no ill effects on my mother, but my brother had rheumatism as a result of the fall, and for six weeks could not be handled even for dressing. After this time elapsed he recovered completely.

Second Prize

The Perpetrator a Victim

By Clarence H. Mason

AS a boy at Vernon, Texas, there were no stock laws, and many times we were forced in the summer to take our cows and horses to the town square to water them. As was usual in those days, the water had to be pumped by hand, and



Giving an electric shock to a thirsty farmer. A shock to the experimenter followed, but not an electrical one.

each pump had a tin cup tied by a string for the convenience of thirsty humans.

The writer and several of his boy friends secured a hand bell-ringing generator from one of the early telephone boxes and by turning it rapidly could give quite a shock with it. We placed a tin tub on a dry box and wet the ground around it to make a good ground, and then attached a copper wire to the tub of water. When a cow or horse got to drinking we would quickly connect the tub to the generator, which was being operated. The shock, going through water and animal, would so surprise and shock the animal that many times they would fall to their knees and then scamper away in fright.

This seemed very funny to us boys until we grew bolder and looked for other worlds to conquer by attaching the wire to the tin cup at the pump and tried the stunt on a farmer. The shock he got gave us a shock, and the thrashing we received is still remembered vividly by the writer. After this we always maintained "Some people just cannot take a joke."

Fourth Prize

Fatal Shock

By James McDonald

Fatal shock received while a dangerous wire was being cut with an axe. One end of the wire touched the person's wrist with deadly results.

ONE day I was walking in the street just after a heavy rain and a high wind that had lasted about an hour. A high-tension wire had become loosened from an insulator on one of the poles and the wire had fallen almost on the sidewalk.

A young man living near where this wire was lying observed the danger and decided to pull it away from the walk. He went into the house and got an axe, wrapped an old coat around the handle and went out to the place. With one swing of the axe he had the wire cut.

But one end of the wire coiled up and wrapped around his wrist, which was bare for the space of about an inch. His mother was standing on the porch watching him as he went out to clear the sidewalk of the wire which threatened the life of anyone who happened to touch it, little realizing what would happen to himself.

The man was instantly killed by the high voltage. The wire seemed to pick out the inch of unprotected surface on his arm.

$37.50 IN PRIZES

We take pleasure in offering a series of prizes for letters giving odd and unusual electrical experiences.

First Prize	$20.00
Second Prize	$10.00
Third Prize	$5.00
Fourth Prize	$2.50

Nearly every one of us has had an odd or unusual experience in electricity, sometimes humorous, sometimes pathetic, sometimes puzzling, and it would appear that our readers should let us have some of their personal experiences for the benefit of all.

The more unusual the experience, the more chance you have.

Illustrations are not necessary, but the letter should be either typewritten or written in ink. No penciled matter can be considered. Contest closes on the 15th of month of issue.

If two contestants should send in the same winning experience, both will receive the same prize. In the event of two or more persons sending in the same as best, second best, etc., each tying contestant will receive the prize tied for.

Prize winning letters will be judged as follows: The first prize will be awarded for the letter giving the oddest or most unusual experience. The second prize to the one considered next best, and so on.

Communications to this department should be addressed *Editor, Odd Electrical Experiences,* care PRACTICAL ELECTRICS, 53 Park Place, New York City, N. Y.

Third Prize

Sawing Through a Three-Wire Moulding

By E. C. Meilloret

SOME years ago when walking up Fulton street I came in front of a store which was being remodeled, having the entire front removed and a new floor laid. There was a heavy three-wire moulding coming up from the cellar to the floor above. Of course the proper thing to do was to notch the board around the moulding, but the carpenter evidently was not an electrical engineer, and he laid his floor board against the moulding and before I had time to call to him had his saw through the moulding.

I do not know what happened down at the meter, but I do know that between the flash and the report which came so unexpectedly that carpenter became temporarily insane; like a streak of lightning he was out in the street, shouting at the top of his voice everything he could think of—"Fire," "Police," "Murder," "Thieves," "Help," etc.

Effect of cutting a three-wire moulding while wires were carrying current. It was bad for the saw.

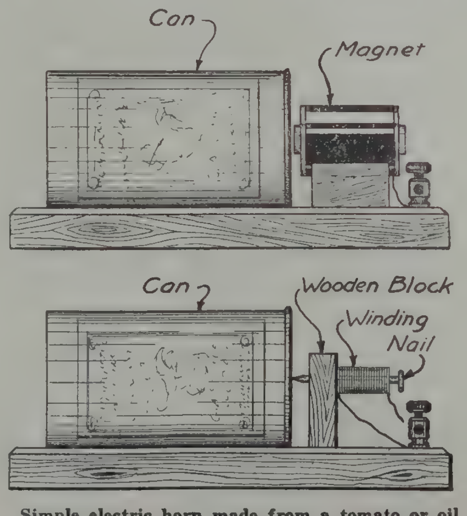
The fire was put out with the help of the extinguisher from the store next door, but the saw looked like a slice of watermelon after being in a darky's hands a while.

Electric Horns

ELECTRIC horns while of the simplest possible construction, offer a larger variety of sounds than any other type of horn. They consist of a magnetic diaphragm and an electro-magnet operated by an alternating current. The alternating current is essential for the horn's operation as the vibrations of the diaphragm are due to the pulsations of the current which create a magnetic core of varying intensity, attracting the diaphragm with varying force.

The construction of these horns is obvious from the diagrams. Any can and any electro-magnet may be used with success. The horn may be a five-gallon oil can with a small magnet from a door-bell, or it may be a very small can with a large magnet. The current may be anything that the winding will stand. Those are the only conditions; now build your horns.

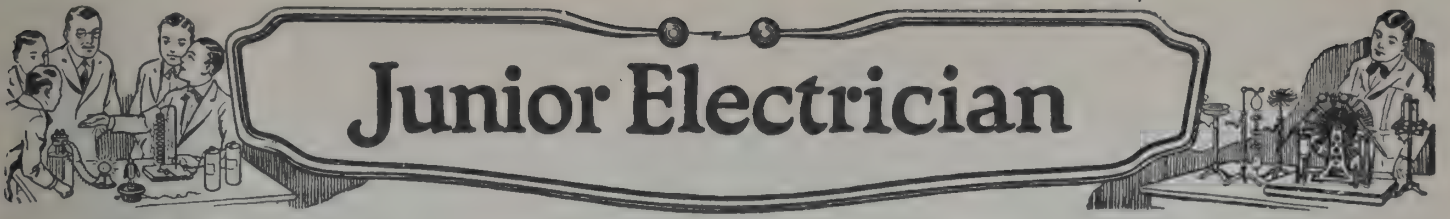
Every can will have a distinctive range of sounds, hence it is difficult to build two that sound exactly alike. The noise produced has as its factors—the strength of the current, the size of the can, and of the magnet, and the distance between the core end and the bottom of the can. I suppose the frequency of the current determines the pitch of the sound, but I only had at my disposal the ordinary sixty-cycle house current. By varying these factors, any sound may be produced from a low, indistinct hum to a deafening roar or screech. In general, the larger the can or the diameter of the bottom, the lower will be the pitch of the sounds produced.



Simple electric horn made from a tomato or oil can and an extemporized electro-magnet which will give loud though possibly not agreeable sounds.

The other diagram shows a horn of identical construction, and is introduced merely to show the simplicity of this home-made device, the magnet in this case being an iron nail wound with insulated wire. The current, in all cases, was obtained from a toy transformer. Such variations as mounting the magnet inside the can, of mounting the can vertically with the magnet in the base, or of using a diaphragm other than the bottom of a can, will readily suggest themselves to the genuine experimenter.

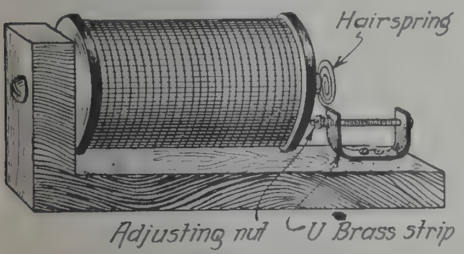
Contributed by Robert Rollins.



Junior Electrician

Watch Hair Spring Relay

A SENSITIVE relay is a very useful device and should be included in the equipment of every experimenter, but the high cost and difficulty of construction are the drawbacks. A variety of interesting experiments can be performed with the aid of such an instrument.



Ingenious relay utilizing the hair-spring of a watch as the armature of a magnet, giving an exceedingly sensitive instrument adapted for slight currents.

The relay described in this article is remarkably sensitive and will pass sufficient current for most purposes. When perfectly adjusted it will respond to current so weak that a 75-ohm receiver will barely sound.

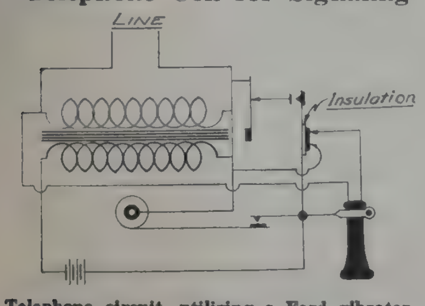
The illustration shows clearly how the relay is constructed. Most of the parts can be found about the house and but a few minutes are required to assemble it. The important parts are the hair spring from a watch and a good magnet with a soft iron core. The latter can be made by winding a small iron bolt with small insulated wire about No. 22 or smaller.

Fasten the magnet horizontally on a wood base and lead wires from it to binding posts. Bend a piece of brass strip 2 inches by ½ inch into a "U" shape and screw to the wood base so that one leg of the "U" is touching, or is just under the lower edge of the end of the iron core, which should project slightly from the coil of wire. Through two holes in the "U" strip insert a small bolt with a nut as shown in the picture; this is the adjusting device.

Solder the hair spring to the leg of the "U" strip next to the magnet. A wire is soldered to the iron magnet core and another wire is soldered to the "U" strip. These wires go to the two binding posts of the relay circuit. To adjust the relay turn the nut on the bolt, which will cause the two legs of the "U" strip to approach or separate, which action makes the hair spring approach and recede from the end of the iron core. In this way the sensitivity of the relay is adjusted and varied. The relay connections are the same as in any other relay.

Contributed by H. P. CLAY.

Telephone Coil for Signaling



Telephone circuit, utilizing a Ford vibrator, so as to send signals without using a bell.

THIS telephone and circuit will give efficient service over very "weak" lines or lines poorly insulated, more properly speaking. As much battery should be used as the transmitter will permit; a Ford vibrator adapted for a 250-ohm coil is mounted in front of the coil, and all signals will come into the receiver.

The writer has used 22 telephones on a barb wire fence and obtained fairly good service several miles apart. No bells or buzzers are required, the coil and receiver do everything.

Contributed by CHARLES CLIVER.

Magnetic Rectifier

DESCRIPTION and constructional details of a magnetic rectifier as made by myself are given herewith.

Interesting Articles to Appear in April Practical Electrics

Detecting Icebergs at Sea

Hot Wire Ammeter
By Harry R. Lubeke

Odd Telephones
By Clyde J. Fitch

Investigation—II
By Esten Moen

Giant Insulator

Demountable Storage Battery

Building a Radiomicrometer
By Dr. Russell G. Harris

Electro-Magnetic Induction
By Harold Jackson

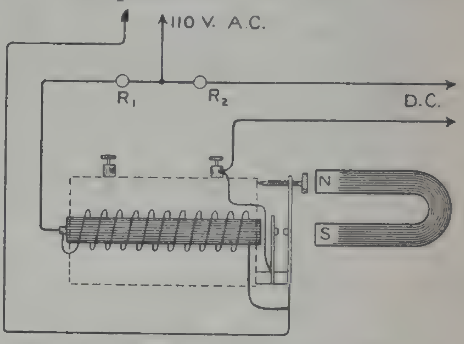
Analogies and Others
T. O'Conor Sloane, Ph.D.

In charging storage batteries from an A. C. source, a rectifier is necessary. There are several types on the market, but they are all comparatively high priced. By means of a Ford spark coil and a permanent magnet I have constructed a magnetic rectifier which works very well. The diagram shows how it is done.

No changes in the spark coil are necessary. The permanent magnet is placed so that one of its poles is just opposite the core of the coil but not too close to the vibration, (R_1) is a resistance of such value as to allow about one ampere to flow through the coil primary. (R_2) should be of such value as to give not over 2 amperes in the D. C. circuit.

(R_1) may be a 100-watt lamp and (R_2) may be a small hot plate or flat iron. Continued use will not harm these, as they are not heated much. The amount of current can be controlled by (R_2). However, too great a current intensity will ruin the vibrator points in a short time.

The current flowing through the coil primary magnetizes the core with the poles reversing with the current. This tends to make the vibrating armature vibrate in synchronism with the frequency of the current. The vibrations are not strong enough to operate the contacts. If a permanent magnet is placed so that one of its poles is in the field of the coil core it will strengthen the vibrations greatly by successively repelling and attracting the armature, depending on whether the core of the coil and the magnet have like or unlike facing poles.



Magnetic rectifier in which the action of the armature is intensified by polarization from one pole of a permanent magnet facing the electromagnet.

A step-down transformer giving potential about 8 or 10 volts could be used. This would eliminate a great part of the resistances. It should be noted that the secondary of the spark coil is not in use.

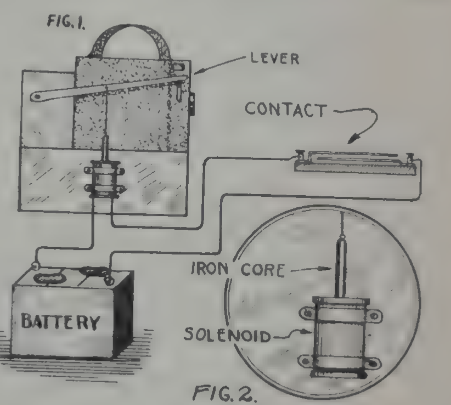
Contributed by GEORGE R. OFELT.

Electrically Controlled Camera

HAVE you ever wished to take pictures of yourself alone, or in groups where everyone could be included in the picture? Then here's the chance for arranging a camera for this purpose.

Any ordinary camera or kodak may be used. It is mounted on a wooden support or frame as shown. A long wooden or metal rod is fastened on a pivot so that one end rests on the lever of the camera, but care should be taken that this lever is not too heavy, for this would cause the lever on the camera to be thrown by the weight of the long lever.

Directly under the camera and lever is located a solenoid. A small armature is suspended from the lever by means of a string or piece of wire. This should be of such length that when current is passed through the solenoid the armature will be pulled into it, and thus draw the long



Attachment to a camera for operating the shutter by electricity, available by a special gravity switch for making animals take their own photographs.

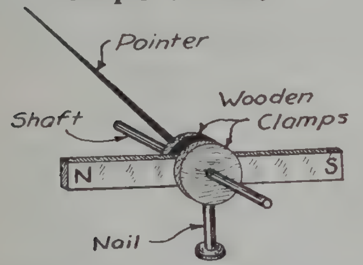
lever downward, throwing the shutter lever of the camera. Figure 2 in the illustration shows how the solenoid is arranged.

In the illustration, Figure 1 shows a general view of the arrangement together with the method of wiring with the battery and the contact piece. For the use described above a small switch or push button will serve the purpose quite well. When used for photographing animals and birds a platform switch, such as shown in the illustration may be used, letting the bird or animal make the contact by its weight. The switch is made of two pieces of metal bent and fastened on a base as shown.

A camera with this arrangement will prove excellent for photographing wild animals and birds as the photographer may be quite a distance from the camera, or may even let the animal make the contact as described above.

Contributed by Evermont Fisel.

Simple Voltmeter



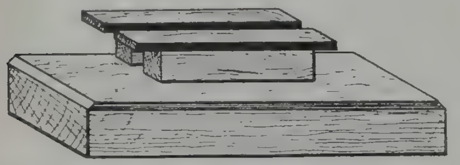
Permanent magnet, shaft, counterpoise and pointer of a simple yet highly effectual galvanometer.

THE voltmeter described below is very simple and inexpensive, but quite sensitive.

A board five inches long and two inches wide is used for a base. In the center of the base cut a slot one and one-half inches long and one-half inch wide. Along each side of the slot a piece of wood one and one-half inches long and an inch high is glued. Two small wooden strips are fastened to the tops of these blocks as shown in the illustration. Using this as a bobbin wind a coil composed of 200 turns of No. 36 insulated wire around it.

Cut a piece of a watch spring one and one-half inches long. Heat this in the center until it is red hot, taking care to keep the ends fairly cool. The purpose of heating this steel is to take the temper out of it so that a shaft which is made from an ordinary sewing-needle one-half inch long, can be driven through it.

The spring is fastened to the needle in the center by two small round wooden or pasteboard disks, which fit tightly on the shaft. A little sealing wax will make everything firm. A piece of broom straw about three inches long is used for a pointer. This is fastened in a slanting position to one of the disks of wood. A nail is also cemented to the bottom of the other disk. This nail serves as a counterweight.

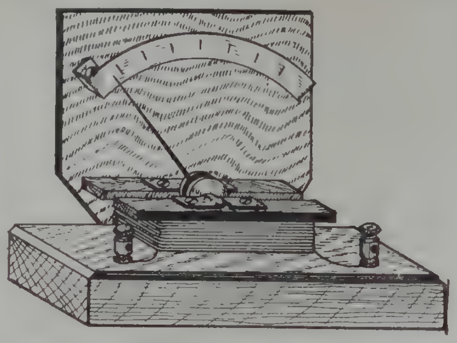


Baseboard and wooden core and frame on which the coil of this galvanometer is wound. The magnet works within the slot.

To magnetize the spring wrap a few turns of magnet wire about it and connect the terminals to a battery for a moment.

The needle is mounted between too pieces of sheet brass, each one inch long and one-half inch wide. Bend each strip at right angles in the middle and one-quarter of an inch from one end make a small dent.

The strips are now slipped down in the center of the slot in the coil with the dents inside of the coil exactly opposite each other. When this position is found they are fastened in place by four very small screws.

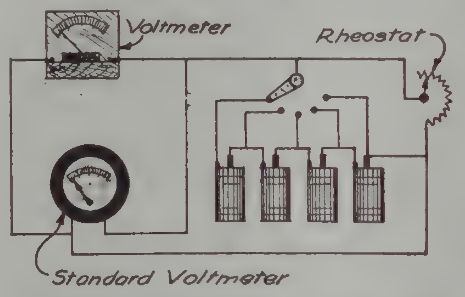


Entire mounting of the galvanometer, the needle moving over a scale carried on a vertical board, making a very presentable instrument.

The sharp pointed sewing-needle together with the magnetized spring, pointer and counter-weight slips down into the dents made in the strips and swings freely there.

Fasten an upright board, four inches wide and five inches high to the baseboard, back of the bobbin attach a piece of thick cardboard to the upright by means of small blocks in such a position that the pointer swings very close to it but does not touch it.

The meter is now complete except for the calibrating, which is done by comparing it with a standard instrument.



Testing the voltmeter, using a standard instrument for the current.

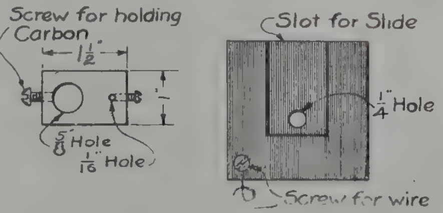
Electric Furnace

A VERY efficient electric furnace is described herewith. An old flower pot, a graphite crucible, an old carbon brush or carbon block, some asbestos paste and some sheet asbestos are required.

A small hole is drilled in the bottom of the crucible, about one-quarter inch in diameter. A hole of the same size is drilled in the center of the carbon block. Cut a slot in the carbon block about one-eighth inch deep and one-half inch wide.

An asbestos board slide is then made to fit this slot, so as to act like a valve gate. A small piece of iron wire is fastened to the end of the slide for use as a handle.

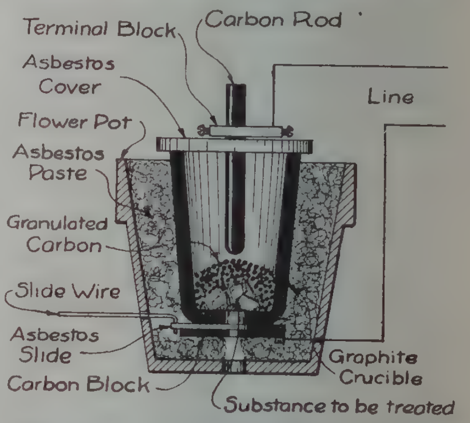
Drill two holes in the side of the flower pot, opposite each other, one for the wire of the asbestos board slide and the other for the wire carrying the current, which is also fastened to the carbon block.



Details of electric furnace carbon-holder and gate at bottom for opening the apertures for metal to run out.

Fill the flower pot with asbestos paste, place about one inch of paste in the bottom of the pot, leaving a hole in the center in line with the other holes. Put the carbon block in the pot with the hole directly over the hole in the asbestos, having the current wire and the asbestos slide wire pass through the holes in the side of the pot; the slide in place will close the hole below it.

Set the graphite crucible on the carbon block, with the hole in the crucible directly over the hole in the carbon block. Pack asbestos paste around the crucible up to about one-eighth inch of the top of the crucible. A lid is now made for the crucible from half-inch asbestos board with a five-eighths-inch hole in the center to allow a carbon rod electrode to pass through.

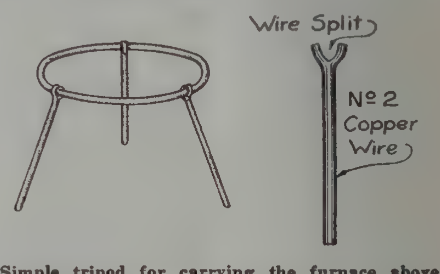


Full detail section of the furnace, whose characteristic feature is that by withdrawing the slide the contents pour out of a hole in the center of bottom while at their maximum degree of heat.

A terminal block for holding the carbon rod and the wire may be made from a piece of brass one and a half inches long, one inch wide and one-half inch thick, with a five-eighth-inch hole in the center for the carbon rod, and a smaller hole in the end for the wire. Each must have a set-screw.

Put the furnace in an oven and bake until the asbestos paste is thoroughly dry. A tripod stand for the furnace can be made from No. 2 wire as shown in the illustration.

To operate the furnace, put the metal to be melted or the substance to be treated in the bottom of the crucible, then pour granulated carbon over the top of it. The carbon rod is now put down through the lid and withdrawn a little so as to form an arc.



Simple tripod for carrying the furnace above the surface of the laboratory hearth.

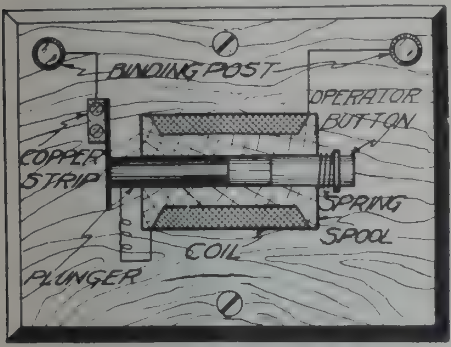
A very high temperature can be obtained with such an apparatus. It can be used to melt copper, brass and iron. When the metal has been melted, the slide is pulled out, allowing the metal to run down through the hole in the bottom of the pot into the mould. A water rheostat may be used to regulate the current.

Contributed by William Stark.

Circuit Breaker

A CIRCUIT breaker is often required to open the circuit in case of overload or "short." A simple, cheap and efficient one can be constructed from the following parts:

A short, soft iron bar of size to move freely through the hole in the spool. A copper strip. A tin strip. A common spool. A length of copper wire of size according to amperes of the circuit.



Electromagnetic circuit-breaker which stays open after the excess of current has operated it and which is reset by a push-button by hand.

First cut a board 3 inches by 3 inches for a base and wind wire around the spool so as to make a solenoid. Next shellac the wire and cut a strip of tin to about the width of the spool. Set the coil and spool on the center of the base and put the tin strip across, and screw down each end with two screws. Bend the strip of copper so that it will be in front of the holes and one-quarter inch from the face of the spool as shown.

The bar, the plunger or armature of the solenoid, should reach the spool when touching the copper strip. Now connect the copper strips halfway through the copper strip to one of the binding posts and one end of the coil to the other post. The other end of the coil is soldered to the plunger. The plunger should work freely or the breaker will not open the circuit. An overload on the line will draw the plunger into the spool and will open the circuit.

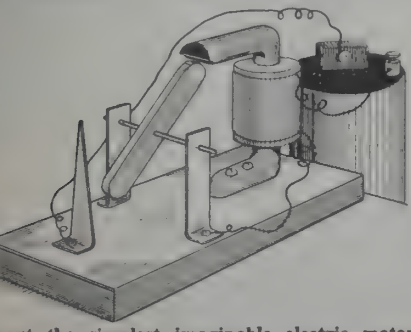
When the breaker pulls open and the overload is taken off, or the "short" is removed, there must be a way of pushing the plunger back. A spring and a wooden plunger are therefore placed in the other end of the spool to use in pushing out the little bar until it touches the copper. Now, when the circuit is shorted, the coil will pull the plunger and open the circuit. As long as the plunger lies back in the spool so as not to touch the copper plate, the circuit is open. Upon pushing the plug the plunger will again close the circuit as it touches the copper. The plunger is connected in series with the line.

Contributed by JAMES DAY.

Simple Motor

LIKE the well known "Lizzie," this contraption is not a self-starter, but may be cranked by spinning the flat piece of iron that constitutes the armature. The list of principal materials required is as follows:

- 1 piece soft iron rod ⅜" dia. × 8" long.
- 1 piece soft iron rod ⅜" dia. × 2½" long.
- 3 pieces spring brass 1/16" × ¼" × 2¼".
- 1 piece steel knitting needle 3" long.



About the simplest imaginable electric motor, but which can attain quite high velocity.

Wind the round piece that is first on the list, which you can see in the illustration, with 25 feet of No. 18 annunciator wire around its central portion. A pair of battery terminals from a worn out dry cell will do nicely for binding posts and to connect the motor to the battery. The longer iron rod can be bent without heating until it is the shape of a letter U as shown. Then make some round pieces of cardboard one inch in diameter, and after cutting a smooth round three-eighth-inch hole in the middle to fit over the iron rod, cut on a line from the hole to the outside of the card and slip in place. Several can be glued together to make a strong spool end, breaking the radial cuts.

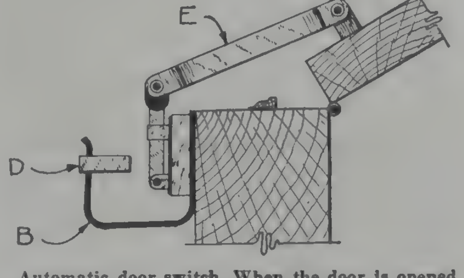
Now wind on your wire. Then after punching or drilling two holes in each one near the ends, bend the two pieces of brass that are to hold up the knitting needle and screw them in place as shown on the base. Tin can be used in place of the brass but is not so good because it is magnetic and interferes somewhat with the working of the motor. The second iron piece on the list is now drilled in the center and fitted tightly to the knitting needle. Soldering or cementing with sealing wax will make it secure. The whole thing is placed between the brass pieces, so that the iron armature nicely misses each end of the C-shaped magnet as it turns. It must be pivotted exactly in its center. The third brass piece is placed behind the armature and makes a contact with it at each revolution. This contact piece must touch the armature very lightly or that piece of iron will not turn.

The wire from the brass contact piece may be extended to a second contact spring, so as to make the contact with the end of the needle shaft bent at a right angle so that it would close the circuit for an instant just after the iron left the other contact spring. This gives more pep and speed.

The end of the knitting needle is too hard to bend without heating, so heat and bend while hot in the shape of the letter "L" that does not have quite a square corner.

Contributed by HARRY L. ELDER.

Automatic Door Switch



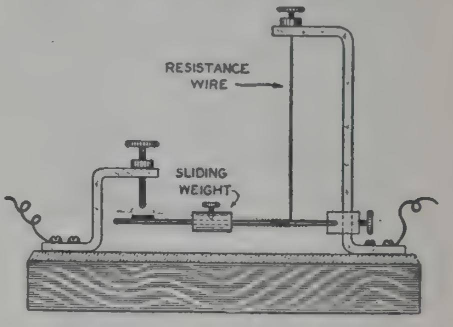
Automatic door switch. When the door is opened this closes a switch so that an alarm bell will ring, or a lamp may be lighted, according to requirements.

THIS is an easily constructed automatic door switch. The main materials required are a single pole, single throw porcelain knife switch, some garter elastic, and a strip of rather stiff metal.

Referring to the diagram; the switch should be mounted at the top of the jamb so that the handle projects beyond it. The strip of bent plate (B), should be fastened under the switch. This strip forms the mounting for the elastic which opens the switch when the door is closed. The elastic (E), should be adjusted so that when the door is closed it wil be loose enough to allow the elastic (D), to open the switch.

Contributed by ROBERT A. WILKINSON.

Magnetless Buzzer



Interesting instrument which gives the sound of a buzzer and operates by expansion and contraction of a thin wire. There is an adjusting weight which controls its action.

THIS buzzer is not a very practical one, yet is an interesting novelty. To make it, a piece of resistance wire about eighteen inches long is suspended from the standard as shown. At the lower end it is connected to the arm, which is hinged to the standard and insulated from it.

A weight is fastened to the wire so as to regulate the tension. A contact is soldered on the vibrator and a contact screw is fixed on top of the arm of the smaller standard. The latter contact screw should be adjustable so as to maintain a contact with the contact piece on the arm.

When the current is applied at the base of the larger standard it travels upward and down the resistance wire, through the vibrator and contacts to the base of the smaller standard. The current heats the wire and expands it, thus the vibrator is let down and the circuit is broken. The wire cools and contracts, thus closing the circuit, and so on.

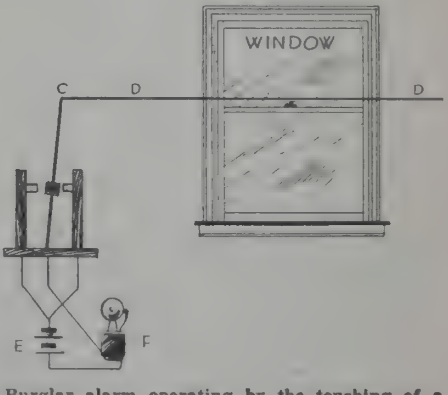
String Burglar Alarm

THIS burglar alarm will work both ways, *i.e.*, if the string is cut or if it is pushed.

(D) is a string stretched tightly across the window. (D) fastens to (C) a small flexible spring bearing two contacts, one on each side.

If a burglar enters the window he will naturally run against the string, therefore, pulling contacts (C) and (A) together closing the circuit containing the battery (E) and the bell (F), causing the bell to ring; or if the string is cut, lever (C) springs back and touches the other contact (B), which also causes the bell to ring.

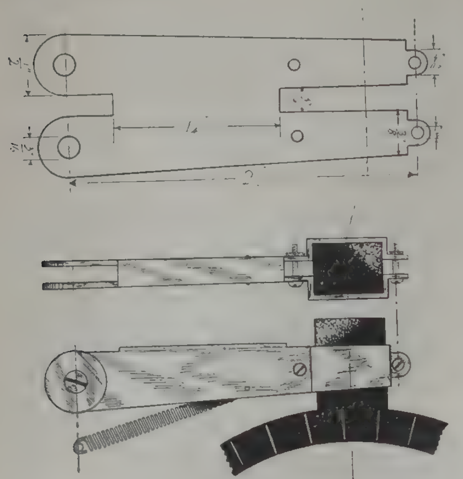
Contributed by FRED HALL.



Burglar alarm operating by the touching of a thread when a burglar attempts to enter. Whether the thread is broken or tightened, the alarm rings.

Simple Brush Holder

A SIMPLE brush holder, which will give satisfactory results, is constructed in the following way:



Brush-holder made of brass plate bent to shape and riveted up or bolted, giving an effectual part for building up a brush rigging.

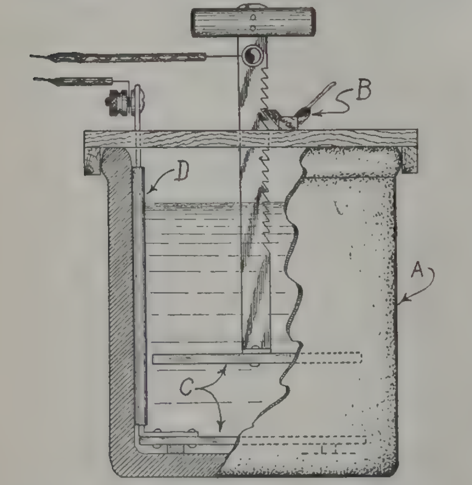
It is made of sheet brass about one-sixteenth inch thick. The dimensions are given in the pattern drawing. Tinner's shears are used to cut the metal. The holes are not drilled until the metal is bent into shape so as to insure their alignment. Two small bolts are provided to clamp the brush in place and when loosened to allow the brushes to be fed through the holder as the carbon wears away.

The holder is pivoted at the back end and is held against the surface of the commutator by the action of a spring arranged as shown in the illustration. Brushes to be used in the above described holder can be made from old battery carbons. The carbons are filed down square or rectangular, to a size ½ inch by ⅜ inch and about ⅞ inch long. The brush is then clamped in the holder by means of the two small bolts.

Water Rheostat

A WATER rheostat for controlling rather heavy currents can be constructed in an ordinary one gallon crock, as shown at (A).

As illustrated, there are two brass discs submerged in the solution, one of which is stationary, resting on wooden strips at the bottom. The other is secured to a brass strip as shown. This strip is notched, ratchet fashion, on one side and is held at any height by a pawl, shown at (B), the pawl being screwed to a wooden strip which spans the top of the jar.



Water rheostat. One plate is suspended by a ratchet bar and the plate is held a proper distance from the lower one by a pawl catching the teeth of the bar.

A binding post is provided near the top of the notched strip, to which one wire is connected. The other binding post is mounted on a second brass strip or rod which is riveted to the fixed plate. A piece of rubber tubing is slipped over this rod to prevent contact with the movable plate, as shown at (D). The electrolyte can be salt water.

Contributed by HAROLD JACKSON.

Automatic Night Light Switch

WITH this device attached to one leg of the bed the occupant retires with the lights on. A person's weight in the bed automatically extinguishes the light. If you arise in the night the lights are automatically turned on as soon as your weight is removed from the bed.

As shown in the illustration, one caster is removed from a leg of the bed. The weight of the bed is supported by a stout compressor spring to a height of one-half inch above the block. An iron lever is arranged as shown so that the push button is depressed by the bar when the bed is unoccupied.

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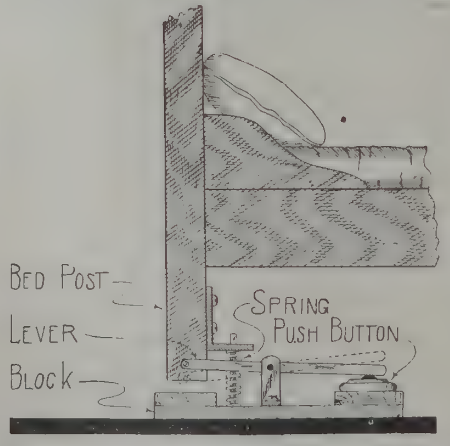
EDITOR.



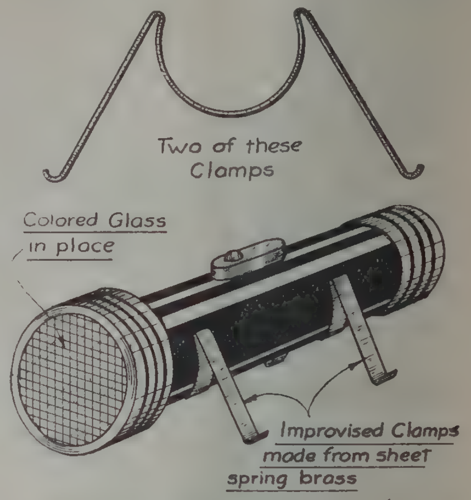
As long as the occupant is in this bed the room will be dark as far as electric light is concerned. But when he leaves it, a lamp switch will automatically close and the room will be lighted.

The push button is so connected into the lighting circuit, that the weight of a person in the bed, through the medium of the lever, will open the circuit. This device will prevent a lot of hunting around in the dark for the lighting switch.

Photographer's Safe Light

ANYONE who has occasion to use a dark room and a safe light will find that a very practical, cleanly and easily carried developing lamp can be made by substituting a disc of orange and ruby glass for the clear glass or lens in a pocket flashlight.

Other colored glass, such as green, can be used when highly colored sensitive plates are used, such as panchromatic. Its many uses will be obvious and will in no way interfere with the use of the flashlight. For instance, when necessary to load a plate holder, to develop a roll of film or plate, etc., remove the white glass from the flashlight and slip in the colored glasses as required. Any dark closet will do, as there will be no danger from fire and no disagreeable fumes as when oil or candle safe lights are used.

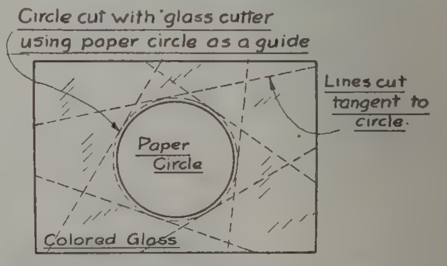

Two of these Clamps
Colored Glass in place
Improvised Clamps made from sheet spring brass

Photographer's lamp made with a mailing tube or similar piece, carried on brackets, and provided with a colored glass to make the light non-actinic.

To cut the glass discs it will be necessary to make two paper discs of the diameter of the glass already in the flashlight. Paste these on the orange and ruby glass as a guide, then take an ordinary steel-wheel glass cutter, which can be procured for ten cents, and carefully follow the edge of the paper circles.

It will be well to mention here that colored glass cuts a little differently from white. The cutter does not make much of an impression the first time the glass is gone over, the surface appearing to be very hard, but on going over it the second time a very clean cut will result; at the same time the glass will scale a little at the point of contact with the cutter, but this is not alarming as a clean cut will result.

Lines should then be cut tangent to this circular cut and the pieces separately tapped off. Figure 1 shows the paper disc pasted in position on the glass and the lines cut tangent to the circular cut at the edge of the paper disc. After being cut the glass discs can be smoothed up on the edges by rubbing them on a whetstone kept well wetted, carborundum being the best.


Circle cut with glass cutter using paper circle as a guide
Lines cut tangent to circle.
Paper Circle
Colored Glass

How to cut out the glass disc. Simple for ordinary glass, but not so easy for colored glass.

Figure 2 shows the flashlight fitted with two improvised clamps made of thin spring brass sheet that can be sprung on and off, the same acting as feet to elevate the light slightly above the surface which it will rest on, and also to prevent it from rolling off the bench or table.

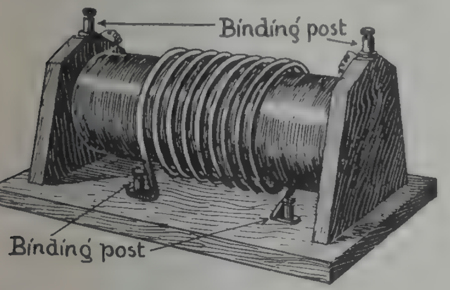
Contributed by FRANCIS G. LE MERLE.

Tesla Coil from Tuning Coil

THE tube was removed and rewound with No. 34 D. S. C. for the wire. The primary secondary winding is made from ⅛-inch copper strip.

Start and end the secondary winding one inch from the end of the tube; also start and end the primary one inch from the ends of the secondary, or two inches from each end of the tube.

Contributed by RAPHAEL DE LEON.



Tuning coil stripped and rewound to give a Tesla coil for high frequency experiments. The ends of the secondary winding must be kept two inches from each end of the tube.

Carbon Contact Rheostat

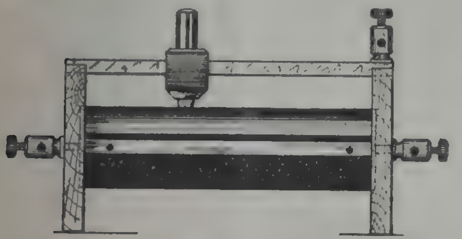
PROCURE an old dry cell either of the large or of the flashlight variety, carefully remove the zinc container and carbon granules and take out the center carbon stick.

After this is done, with a three-cornered file make a straight groove lengthwise on the carbons (as in Fig. 1). Next get a drill about one-eighth inch in diameter and drill a hole in the center of each end about three-quarters of an inch deep, as in Figure 2. Then drill two holes on an upward slant so that they reach the center one; do this at each end, as in Figure 3.

Now to make the end connections we take two pieces of wood about two inches square and one-half inch thick. With a drill of the same diameter as the carbon to be used drill to a depth of about one-quarter inch and at the center of this circle drill through the rest of the way with a one-eighth inch drill; do this to each block, as shown in Figure 4.

To assemble the complete instrument we need a rod and slider, which can be obtained at any radio store, and three binding posts.

After we have everything ready we assemble by placing the mounting screw, a round-head machine bolt, for the binding post through the small hole in the end blocks, and then into the center hole of the flashlight carbon. Now take a hacksaw and saw off the head of the machine bolt so that it will go into the binding post.



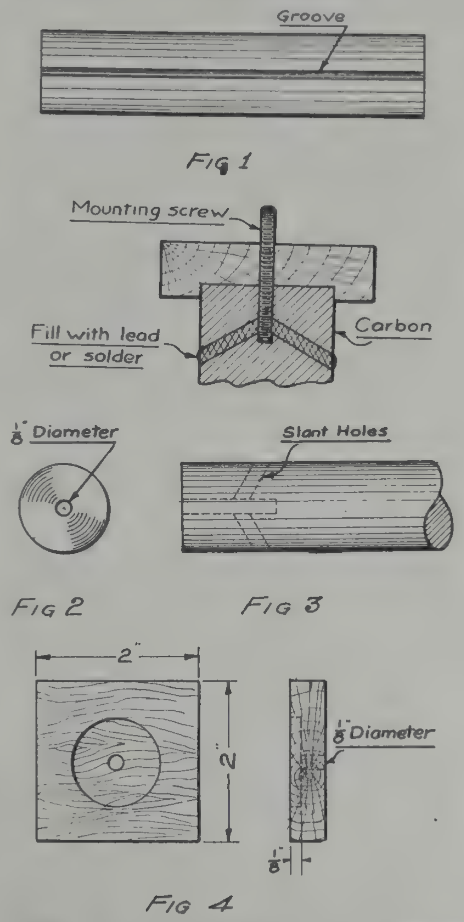
Very nice construction of a rheostat. It is a carbon securely mounted and provided with a groove through which the sliding contact moves to vary the resistance. An old battery carbon is the basis of the apparatus.

Now with a soldering iron or alcohol torch melt the solder and fill up the two holes that were drilled on a slant up to the center hole drilled in the carbon. After putting on the binding post there will be a tight end and a positive connection with the carbon. This operation is done to each end and you have two binding posts.

For the third or variable contact the slider is screwed or fastened down in place (with the slider) with staples and a connection is made on this rod, either by drilling a hole in the end and mounting a binding post there or by soldering a wire to it.

When this instrument is finished it is neat in appearance and is very efficient. The end supports can be stained and shellacked to add to its attractiveness.

Contributed by REGNER A. EKSTROM.



Full details with dimensions of the rheostat shown in the preceding picture. The use of the holes filled with lead or solder gives a specially good connection for the binding posts to insure low resistance at the ends.

Indicating Ohmmeter

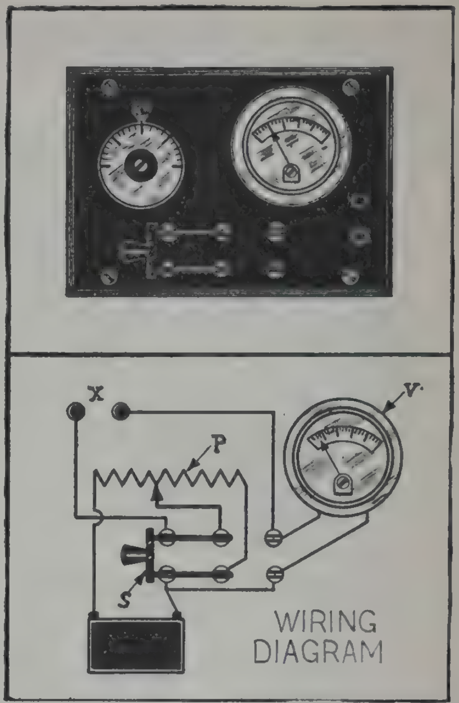
AS the name suggests, this instrument indicates directly the resistance of any electrical apparatus which happens to be hooked up to it; that is, providing they are within the range of its capacity. The principle of operation is quite simple, as will be seen from the diagram. First let us imagine that we have a resistance, a source of voltage and a voltmeter, all of which are connected in series.

Now if the resistance is varied the voltmeter reading will vary to a corresponding degree. Thus by having a known variable resistance connected in series with the meter and adjusting it to different values, the scale can be calibrated so as to read resistance in ohms.

It will be clear that if the meter were calibrated when connected with a definite amount of voltage, then this voltage should not change, otherwise the instrument will indicate the wrong number of ohms.

As the voltage of the battery is liable to vary, a switch and potentiometer have been connected in the circuit in order to correct the voltage.

Therefore, before connecting the unknown resistance across the binding posts (X) the switch (S) is thrown to the right-hand clips and the potentiometer (P) is adjusted until the meter indicates the correct value of voltage. Now the unknown resistance may be placed across (X), and by throwing the switch to the left the meter will indicate its resistance. The switch (S) has been arranged so that it will cut out the resistance element of the potentiometer, and therefore it should be open when the instrument is not in use. Best results will be obtained with this ohmmeter when the resistance to be measured is not small compared with the resistance of the voltmeter.



Indicating ohmmeter. A voltmeter is so connected that its readings can be calibrated to give ohms of resistance in the circuit or appliance under trial.

In measuring small resistances the voltmeter can be calibrated with a shunt connected across it, or better yet, a milliampere meter may be used in place of the voltmeter.

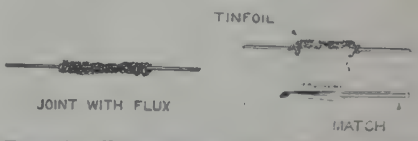
In a number of tests carried out by the writer a 400-ohm potentiometer and a radio B battery were used. A 3-volt voltmeter having an internal resistance of 300 ohms gave excellent results.

However, if it is desired to use a milliampere meter it will be better to use a 150-ohm poteniometer and a 6-volt battery. This battery can be made up of four dry cells connected in series and placed in a box, while the instruments are mounted on the cover of the box.

A top view of the complete arrangement is shown in one of the illustrations.

Contributed by A. GIOLITTO.

Tin Foil for Soldering Wire



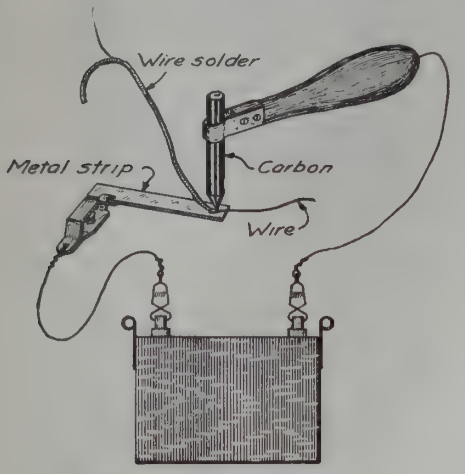
Exceptionally neat way of making a soldered joint on light wire, using a simple match flame as source of heat and tinfoil for solder.

INSTEAD of waiting for a soldering iron to heat up for a small job, use a piece of tin foil and a match and do it in a jiffy. Here's how: Join the parts to be soldered and cover with a little soldering paste. Then wrap the joint with a small strip of tin foil. Hold the flame of the match under the joint till the foil melts, and it's all done. The accompanying illustrations show the procedure.

Contributed by CONSTANTINE TROY.

Soldering Device

THE illustration shows a simple soldering device very useful to the radio builder or car owner. The carbon from a flashlight cell is pointed and fastened to a wooden handle by means of a copper or brass strip. One end of a flexible cord is connected to this strip, and a charging clip is fastened to the other end of the same lead. Another cord has a clip fastened to each end.



Neat arrangement for soldering, taking current from a storage battery and using a pointed battery carbon pencil for the bit.

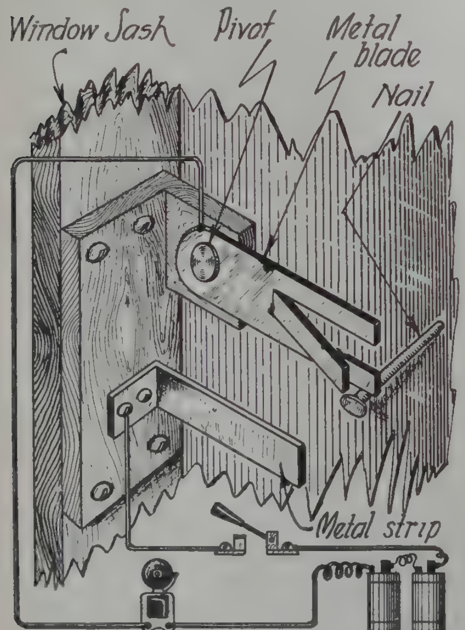
To use, attach the work on one cord and the carbon on the other to a battery as shown. Then with work in readiness bring a piece of wire solder against the joint with some flux, and touch the solder with the carbon point. The solder will melt and flow so as to give a good joint.

The current is furnished by a storage battery such as the starting battery on a car.

Contributed by George H. Malone.

Burglar Alarm That Worked

BEING confronted with the problem of providing sufficient ventilation for a bedroom whose only window opened on the fire escape, in a district where several night robberies had been perpetrated, I essayed to design and install a burglar alarm.



Curious burglar alarm for use upon a window, permitting the sashes to be partly opened, but at the least shifting the alarm rings.

This particular alarm is of especial interest to its originator because one night it actually worked, arousing the whole house and scaring the would-be intruder away. Having been engaged for some time in scientific industrial research, I have learned to respect an invention that works, so I believe there are many other readers of this magazine who will be interested in the simplicity and practicality of the following design, especially since it proved its worth when an attempt was made to enter the window on which it was installed.

The proposition of ventilation and protection mentioned above consisted of providing as much ventilation with as little danger as possible. This involved the opening of the two window sashes not quite wide enough to permit a person to squeeze through, either at the bottom or the top, giving the ventilation. Now for the protection.

Where the sides of the upper and lower sashes overlapped, a hole was drilled through one of the side pieces of the lower (inner) sash and partly through the upper (outer) sash, the hole being large enough to admit a sturdy one-quarter inch bolt from the inside. With this bolt in place, one sash could not be moved without moving the other.

The problem now was to rig an alarm to indicate when the sashes were moved. The way in which the sashes were pinned together left two openings, one at the bottom and the other at the top, neither being large enough to admit a person. But if both the sashes were moved up or down as far as the pin would allow, then there would be a single opening, large enough to admit a full grown yeggman. The proposition was now to set up an inconspicuous, practical alarm out of arm's reach of either opening. This meant up close to the pin that held the two sashes together.

For this purpose I made up a small unit about 2½ inches over-all height, the design being as shown in the illustration herewith. It consisted of a swinging blade and stationary contact mounted on a wooden base. This unit was fixed on the lower sash close to the pin. When set the blade was held horizontal by a nail in the window casing so located that it would hold the blade only when the sashes were in their proper midway position. Now if anyone desired to come through the window he must enlarge the opening either at the top or the bottom by moving both sashes. But when this was done the blade would be moved away (either up or down) from the nail and would drop down and touch the lower contact. This contact passed between the leaves of the split end of the blade and was squeezed quite tight, thus making excellent contact, closing the bell circuit. When the blade was in the down position it completely cleared the nail in the casing and no amount of movement of the window sashes either up or down would open the circuit. The bell would continue to ring until the alarm was reset or the switch opened.

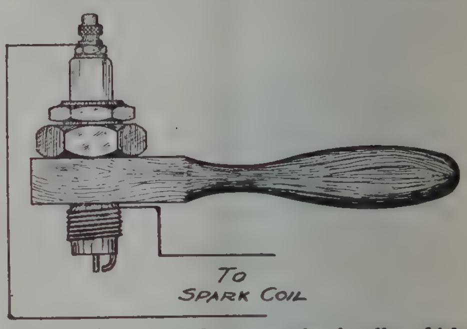
After the alarm was completed full reliance was not placed in it until a long series of tests had been made. A great quantity of experimenting was done by setting the alarm and tripping it by moving the window sashes not over one-half inch from their correct position, and the alarm did not fail once. As stated above, the successful test came when someone attempted to enter the window one night and merely succeeded in informing the whole house of his presence by the ringing of the bell.

The characteristic point is that whether the sash is pushed up or down, it may be for only one inch, the bell will ring, and continue ringing.

Contributed by William A. Tripp.

Spark Plug as Match

TAKE an old discarded spark plug and with a board six by two by one make a handle with a hole in one end to tightly fit the bottom cylindrical end of the plug. Solder a wire also to the lower end of the plug and attach one under the binding post at the top. These wires will then go to the spark coil, which may be encased with batteries so that it will be movable.



Spark plug mounted on a wooden handle, which can be used to light gas lamps, alcohol lamps, gasoline blow-pipes and the like.

This will be found convenient as an instrument to light gas lamps, for starting bonfires, lighting cigars and many other things.

Contributed by Ned Fox.

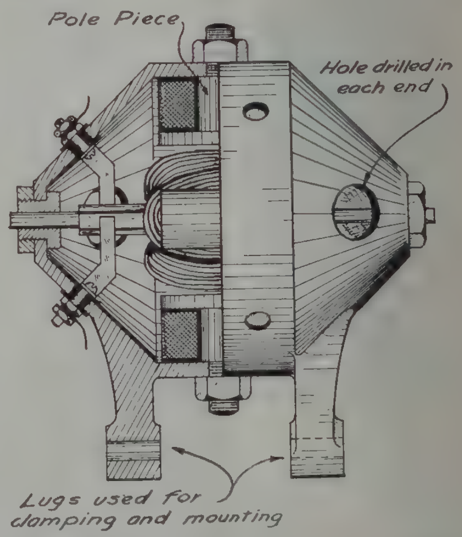
Ford Timer-Shell Motor

MOST experimenters have difficulty in selecting or finding suitable cases in which to mount the armature and fields of their model motors. I solved the problem by using the shells of old Ford timers.

As shown in the illustration, the fibre timing ring and brushes are removed. The casings are then clamped together and holes made for as many field poles as desired on the line where the edges of the casings come together. Pole pieces can then be fitted in these holes.

The armature can be built in any fashion the experimenter desires, and bearings can be made in the end of each casing. The little oil cap and a hole drilled just opposite it can be utilized to mount the brushes.

The extended lugs, found on every timer, may be placed directly opposite each other and used for a mounting bracket.



Compact motor made up of Ford timer casings. Two of these secured together make an excellent mounting for an amateur's motor.

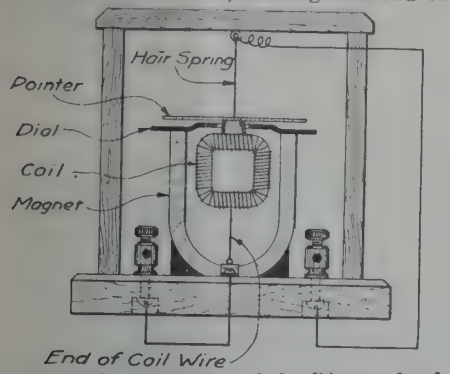
This motor may be wound for any voltage desired and makes a very good-looking appliance.

A large hole should also be drilled at each end to gain access to the motor after assembling.

Contributed by Erskine Baker.

Simplified D'Arsonval Galvanometer

THE illustration shows a galvanometer which is easily and cheaply constructed and is sensitive enough for average work. First mount a permanent horseshoe magnet in the position shown on a wooden base. Next procure some of the smallest insulated wire you can find and make a coil as shown, leaving one end of the wire about six inches long, and then wrap the coil with thread to hold it together. The smaller the wire the more sensitive the instrument will be.



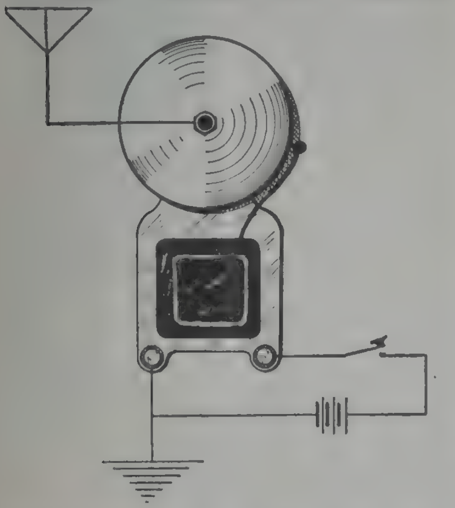
Very simple presentation of the d'Arsonval galvanometer, which though designed only as little more than a demonstration instrument, is really quite practical.

This coil is suspended by means of a section of very fine hair spring, such as used in small wrist watches. This spring should be of nonmagnetic alloy and the smaller in cross section the better. Then fix a piece of small aluminum wire to the top of the coil for a pointer. A dial is fixed to the ends of the magnet which may be calibrated in any way desired. The long end of the coil winding is joined in the center of the bend in the magnet as shown. The magnet is connected to one binding post, and the upper end of the coil is connected through the hair spring to the other post. For best results there should be three screws (A) to level the instrument and a glass bell jar should be placed over the whole instrument to keep out dust.

Contributed by Woodson B. Matthews.

For Solution

THE following we regard as more or less of a puzzle. An aerial was connected to the gong of an electric bell and the signals of the bell were transmitted to a distance of about 150 yards, so as to be picked up with some audibility on a crystal set.



Sending signals from a common electric bell by wireless. If no spark is produced, will it operate?

Owing to the changing electromagnetic field it is quite conceivable that electrical impulses were transmitted from the armature of the magnet through the clapper to the gong and thence to the aerial. Or the simpler solution would be to assume that there was a defect in the insulation. The signals, it will be observed, are key signals, and the grounding of the armature and battery will also be noted.

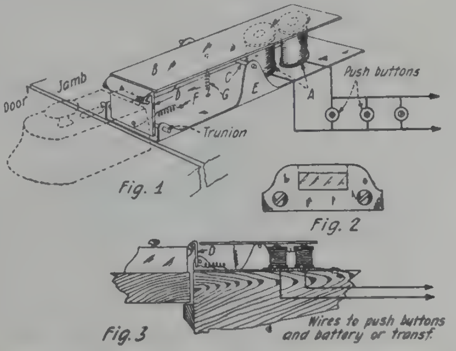
Thus, every time the clapper struck the gong the aerial was grounded, and was also connected to one of the poles of a battery, so there is room for plenty of what Mulvaney, in Kipling's story, called "theourizing."

Contributed by J. M. Wainberg.

Electric Lock

THIS electric door may be unlocked from various places in the room wherever it is convenient to locate a push button.

(A), Fig. 1, is a small electro-magnet; the writer used one taken from a safety switch on an automobile. (B) is an armature made of soft iron about ⅛ inch thick, 1 inch wide and 3 inches long. (C) is a trunnion made from a piece of galvanized wire soldered to the armature. (D) is the catch made of a piece of the same kind of iron as the armature bent as shown in side elevation Fig. 3. This also has a trunnion of wire about ¼ inch from bottom. (E) is the frame for holding the apparatus and should be made of heavy gauge galvanized iron. A pattern may be made from a piece of stiff paper.



Somewhat complicated electric lock, fully described and illustrated, a different version from those hitherto given.

The catch plate, Fig. 2, should be cut out as shown by the dotted lines and the mechanism just described is mounted on the jamb so that (D) fits the notch sawed out of catch plate. It will be found now that when the armature is depressed against the magnet, the other end will clear the top of (D) and when the door is pushed (D) will give out of the way of the bolt in the lock, allowing the door to open. The springs, (F) and (G), keep the armature and catch engaged so that the door can not be opened unless armature is drawn to magnet.

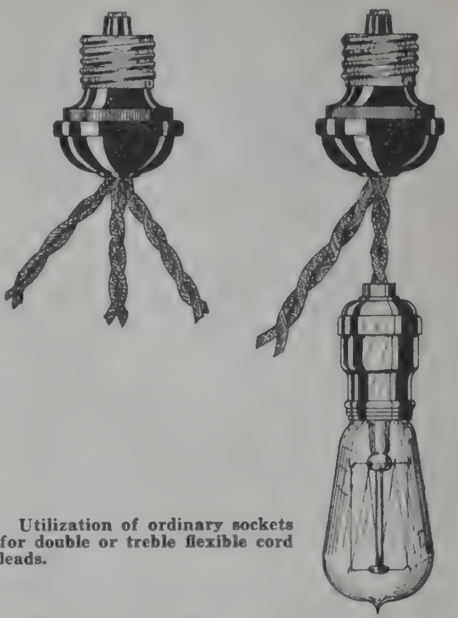
As many push buttons as desired may be located in the circuit. They may be placed on the desks, window sills, door jambs, typewriter cabinet—anywhere convenient. A very neat appearing job may be had by using the small pearl flush-type buttons and concealing all wires, behind base boards and jambs. The writer's office was equipped with such a lock and push buttons located at several points, making it unnecessary to move the bolt when entering the office, and releasing the bolt when leaving. A cover of tin or wood should be made to fit over the entire mechanism.

Contributed by J. Greene Mackenzie.

Double Service from Plug or Socket

TWO and three socket plugs are very useful as they give more than one outlet from the ordinary light socket. Their cost is somewhat high and the experimenter does not like to purchase one because the need for such an equipment may be only temporary. Here are two methods which were used for months and found satisfactory.

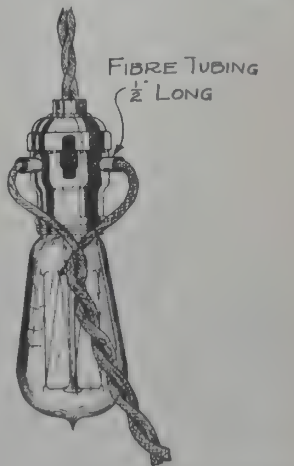
One way is to alter an ordinary light socket slightly. First open the switch in the meter box to avoid shocks and then remove the larger half of the light socket shell and put it away, as it will not be used. Procure another old socket shell that still contains the insulating lining. Bore two holes at the point where the two connection screws touch it. Two pieces of fiber tubing, one-half inch long, are tightly forced into the holes in the socket shell, and then the ends of a flexible light-cord are passed through the tubing and connected to the screws, where the main light-cord ends are fastened. Slip the socket shell in place and the trick is done. The current in the added light-cord is not affected when the socket switch is turned.



Utilization of ordinary sockets for double or treble flexible cord leads.

If the plug is a two part one this can be done in a much better way. With such a plug even three light-cords can be brought from it without the necessity of altering the plug in any way.

All that is required is to force the ends of the light-cord through the hole in the lower half of the plug and connect them to the connection screws. The current is controlled by the light socket switch. The only disadvantage of this method is that no light bulb can be used while the plug is in. Of course, one of the cords could be brought to a wall socket to provide light or an extra light socket could be hung from the plug with three or four inches of cord.



Taking an extra lead from an ordinary light socket so as to make it do double service.

For temporary service the plug method for double use is the best.

Elec-Tricks

JONES ELECTRICAL SUPPLY CO.

IN this department are published various tricks that can be performed by means of the electrical current. Such tricks may be used for entertaining, for window displays, or for any other purpose. This department will pay monthly a first prize of $3.00 for the best electrical trick, and the Editor invites manuscripts from contributors.

To win the first prize, the trick must necessarily be new and original. All other Elec-Tricks published are paid for at regular space rates.

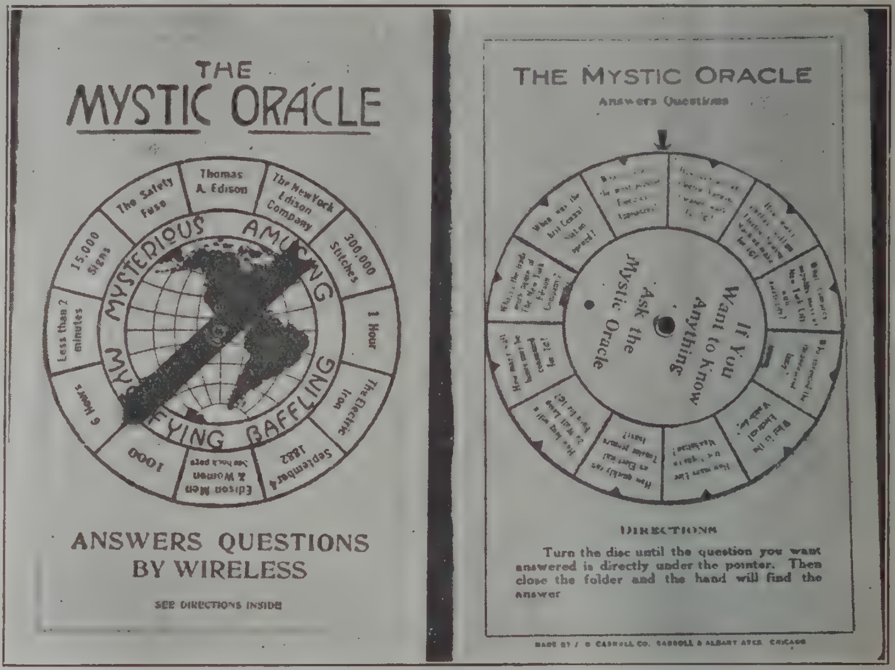
Mystic Oracle

A VERY ingenious advertising circular has been issued by the New York Edison Company. It consists of a card folded in the center so as to close like a sheet of note paper. On the front is mounted a compass needle carried by a small eyelet so as to rotate easily.

There are two concentric circles outside of the range of the ends of the needle. These circles are divided by radial divisions into twelve compartments, each containing an answer to one of twelve questions to be found in the interior of the folder. These questions are arranged in corresponding positions on a cardboard dial, mounted also by an eyelet, so that it can be turned by hand. Directly above it there is an arrow head printed on the card.

To obtain an answer to any desired question, the question or inner dial is turned until the center, which is indicated by a small mark, of the compartment containing the question to be answered, is opposite the mark on the card above the dial. Each compartment has one of the little marks. If now the folder is closed, the magnetic needle swings around and points to the answer.

There is fastened to the lower dial, pretty well out of sight, a strip of iron which rotates with it, and this strip it is which determines the position of the needle.



DIRECTIONS

Turn the disc until the question you want answered is directly under the pointer. Then close the folder and the hand will find the answer

Interesting advertising card which operates by magnetism and answers any one of twelve questions. The question dial is turned to the proper place, for any of twelve questions the card is folded over and the needle points to the answer.

A Game with Static

AMONG the first laws of frictional or static electricity which we learn is, "Like charges of electricity repel each other and unlike attract." It is this law which enables us to have the little floating airships here described.

A stick of sealing wax when rubbed with a piece of flannel or fur becomes electrified. When this electrified stick is brought near a lightly suspended body, an attraction followed by a repulsion takes place between it and the stick. If a piece of gold leaf which can be obtained at a sign-painter's shop or hardware store is flung into the air it will not settle instantly, due to its light weight. Now, while it is slowly settling to the floor, a "charged" or rubbed (electrified) stick of sealing wax is brought under it, and the little piece of gold leaf will be attracted and then repelled by the wax. By keeping the electrified wax always beneath the gold leaf or boat, it can be caused to remain suspended in the air. Moving the sealing wax a little to the side yet still under the leaf, the leaf will tend to move through the air and with a little practice can be guided.

A rather amusing game can be played by several people, each having a stick of sealing wax and a piece of gold leaf. At the word "Go," the players should release their gold leaf boats in the air and then follow them up with the charged sticks to a string hung across two chairs as a goal, the first one "piloting" his "boat" home under or over "the wire," winning the game.

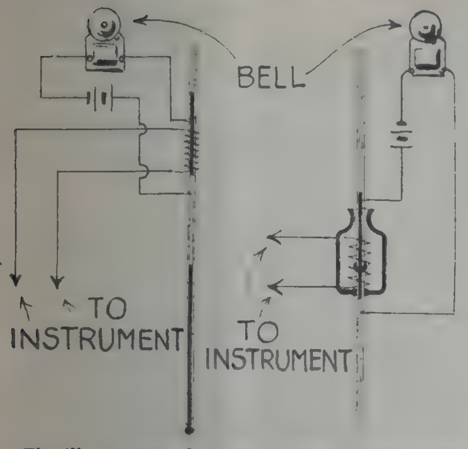
Instead of the sticks of sealing wax, an electrophorous can be used by each player. These consist of a tin lid from a coffee or baking powder can attached to a stick of sealing wax. The charging disc is made by melting sealing wax in a pie-plate and allowing it to cool. The tin lid with the wax handle is placed on the previously rubbed pie-plate containing the melted and cold wax; the tin lid of the stick is touched for an instant and then raised from the pie-plate containing the sealing wax. It is then ready to be used under a piece of gold leaf which has been thrown in the air.

Contributed by RAYMOND B. WAILES.

Game involving the use of an excited electrophorus plate, or for which may be substituted a large stick of sealing wax. Gold leaf floating in the air is directed to cross a string representing the goal.

Latest Electrical Patents

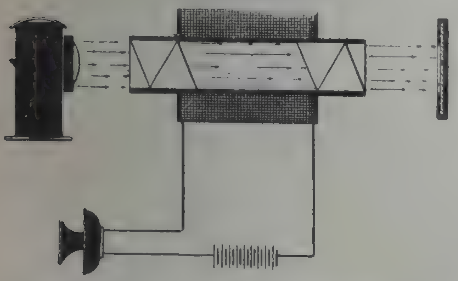
Temperature Relay



The illustrations show two forms of temperature relays, or thermostats, designed to be influenced by changes in temperature of the resistance coil, but not by changes in the room temperature. A capillary tube contains a mercury and an air column so proportioned that any changes in the room temperature will cause both mercury and air to expand or contract, leaving the lower end of the mercury column stationary with respect to the glass tube. An increase in temperature in the resistance coil, however, will cause only the mercury to expand and close the contacts, which may be arranged to sound an alarm or actuate a relay.

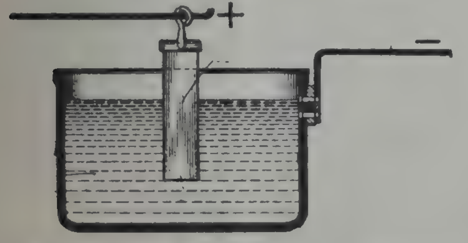
Patent 1,470,676, issued to Niels K. Andersen.

Sound Recording Device



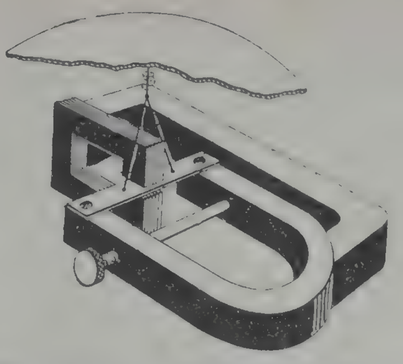
This device was evolved to faithfully record sound vibrations photographically on a moving film. A beam of light is projected through a tube having Nicol prisms in each end, the space between being filled with mercuric potassium iodide or carbon bisulphide. Around the tube is placed a coil energized by a battery connected in series with a microphone. The beam of light is polarized and is deflected more or less, depending upon the current flowing through the coil. A photographic film passes in front of the light beam and records the deflections, which are in synchronism with the sound waves striking the microphone. Patent 1,474,695, issued to D. A. Whitson.

Electrodeposition of Rubber



While we were all familiar with electroplating, few are aware of the fact that rubber coatings may be deposited on a conducting material by a similar method. The electrode is placed in a conducting rubber emulsion, comprising rubber, soap, lampblack, coloring matter, water and sometimes other ingredients, and connecting to a 110-volt D. C. line. Small rubber particles, movable by the electric current, are deposited on the electrode. A current of one-third ampere per square inch of anode surface is sufficient. Patent 1,476,374, issued to S. E. Sheppard and L. W. Eberlin.

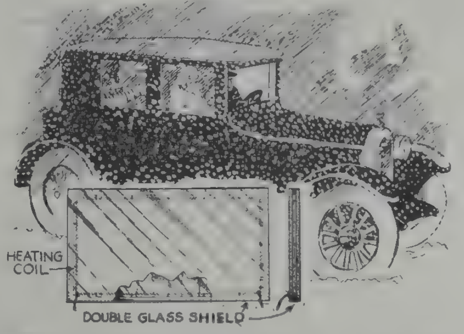
Reed Telephone



This telephone receiver employs a tuned reed, the natural frequency of vibration of which may be adjusted by the thumb-screw. It utilizes two permanent polarizing magnets mounted at right angles to each other, and a small laminated core with an air gap through which the reed passes. The input current passes through a coil around the laminated core and sets up vibrations in the reed, which is attached to the center of a diaphragm. The reed is responsive to vibrations of one frequency only, so that the receiver is recommended for reproducing undamped radio telegraph messages, in which the tone of the signals may be varied at will by the operator so as to be in tune with the reed.

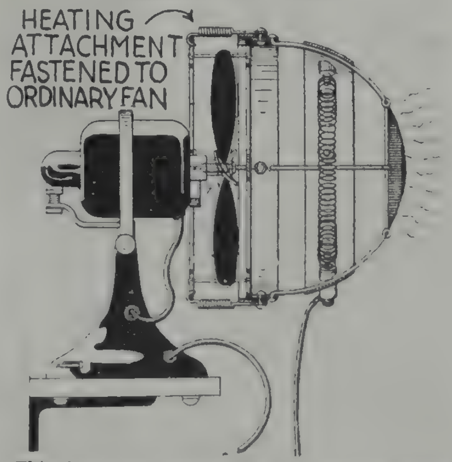
Patent 1,472,341, issued to Greenleaf Whittier Pickard.

Clean Vision Shield



There are many types of electric and hand operated devices for wiping snow, ice and water off of an automobile windshield so that the driver may have a clear view ahead. This clear vision shield has no mechanical or moving parts at all. It consists of two glass shields slightly separated, the space between heated by an electric heating coil that lies along the edges of the two glasses. This heats the entire shield and dissipates moisture. Patent 1,473,029, issued to V. T. Faubert, J. Anekee and C. L. Young.

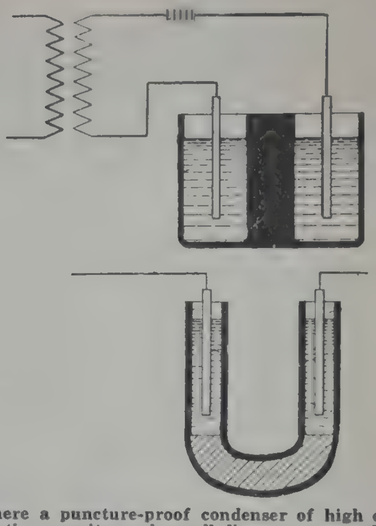
Heater for Fans



This invention provides for an electric heater of standard sizes to fit the regular electric fans now on the market, so that the current of air blown by the fan will be heated. It comprises a heating coil inside of a suitable reflector mounted on the fan guard in front of the fan blades. A stream of warm air is sent out into the room when the current is turned on.

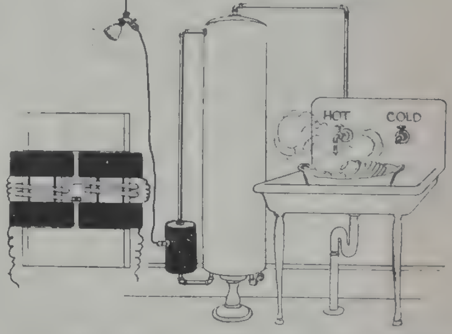
Patent 1,472,124, issued to Frank Morgan Howe and Charles Naegeli.

Electrolytic Condenser



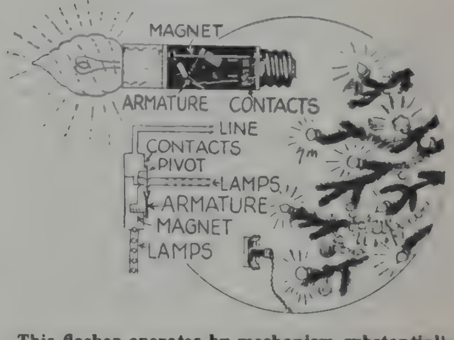
Where a puncture-proof condenser of high electrostatic capacity and small linear or superficial dimensions is required, the electrolytic condenser is usually employed. An improved electrolytic condenser is shown in the illustration. It comprises two compartments separated by a porous material having an acid in one and an alkali in the other, such as sulphuric acid and sodium hydroxide. In these solutions are dipped the electrodes, which may be of lead and graphite. A microscopic film which forms on the electrodes acts as the dielectric of the condenser. Patent 1,473,883, issued to Joseph Slepian.

Electric Water Heater



A water heater in which the heating element forms part or all of the secondary winding of a transformer is considered more efficient than those in which a separate heating unit is employed. In this heater the secondary winding of a transformer is a metal tube, short circuited, through which the water flows. Special attention is paid to the arrangement of the windings, as shown, so as to have both primary coils and secondary tube coil close to the core. Patent 1,474,777, issued to Ladislaus Jarkovsky.

Lamp Flasher



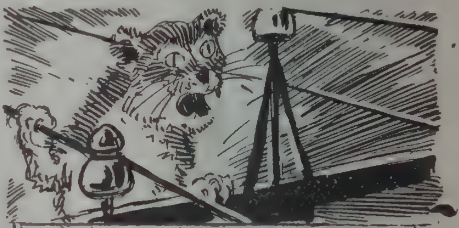
This flasher operates by mechanism substantially that of a buzzer or electric bell. The armature is rather heavy and swings a long distance, the effect of which is that it makes and breaks with comparative slowness, so as to constitute an electro-mechanically operated circuit breaker. Patent No. 1,429,062, issued to Martin V. Cernica.

Short-Circuits

THE idea of this department is to present to the layman the dangers of the electrical current in a manner that can be understood by everyone, and that will be instructive, too. We have given monthly prizes of $3.00 for the best idea on "short-circuits." Look at the illustrations and send us your own "Short-Circuit." It is understood that the idea must be possible or probable. If it shows something that occurs as a regular thing, such an idea will have a good chance to win the prize. It is not necessary to make an elaborate sketch, or to write the verses. We will attend to that. Now let's see what you can do!

Lies sleeping here
  Our baby Maud.
She liked to chew
  The floor lamp cord.
—Joseph F. Odenbach.

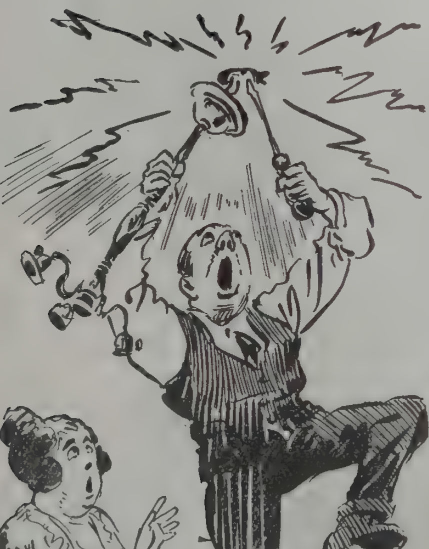
Here lie the remains
  Of Hannibal Joseph Miller.
With his bare foot he stepped
  On the electric mouse killer.
—John K. McCarthy.



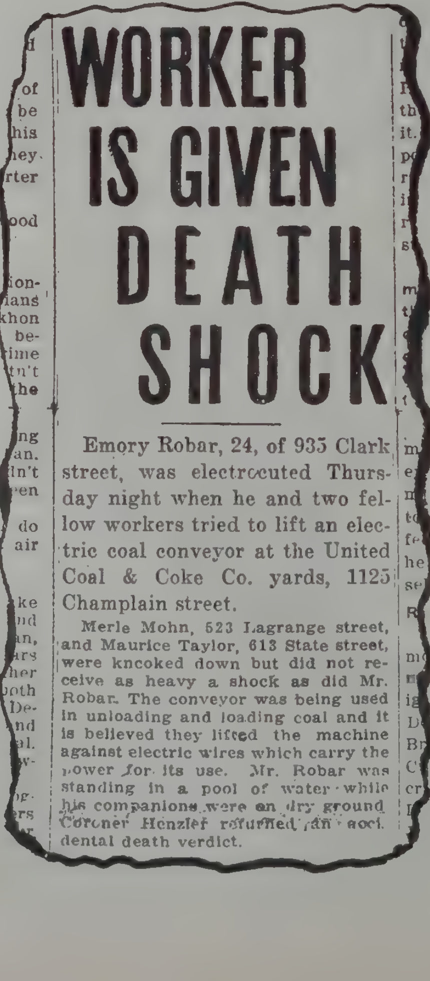
Tom Cat on Pole Tackles Wire; Dies as Lights Go Out

SARANAC LAKE, Dec. 27.—Shortly after midnight last night, a large tom cat climbed a steel tower in Whippleville and came in contact with high tension wires, carrying 33,000 volts from the power plant at Chasm Falls to towns in northern Franklin county. The cat was reduced to cinders and the lights went out for miles around. Power company officials were deluged with complaints and trouble hunters spent a hectic night attempting to locate the short circuit.

These blackened bones
  Belonged to a cat named Tom.
Of his nine lives,
  There remains no atom.
—John Bulger.



These flowers cover
  Old John Jacob Fawn.
He moved some fixtures
  With the juice turned on.
—Fritz Vanderwerth.



WORKER IS GIVEN DEATH SHOCK

Emory Robar, 24, of 935 Clark street, was electrocuted Thursday night when he and two fellow workers tried to lift an electric coal conveyor at the United Coal & Coke Co. yards, 1125 Champlain street.

Merle Mohn, 523 Lagrange street, and Maurice Taylor, 613 State street, were kncoked down but did not receive as heavy a shock as did Mr. Robar. The conveyor was being used in unloading and loading coal and it is believed they lifted the machine against electric wires which carry the power for its use. Mr. Robar was standing in a pool of water while his companions were on dry ground. Coroner Henzler returned an accidental death verdict.

This grave holds
  Plumber John McSnipe.
He used an electric drill
  On a water pipe.
—Ned Guffey.

? How and Why ?

THIS department is conducted for the benefit of everyone interested in electricity in all its phases. We are glad to answer questions for the benefit of all, but necessarily can only publish such matter as interests the majority of readers.

1. Not more than three questions can be answered for each correspondent.
2. Write on only one side of the paper; all matter should be typewritten, or else written in ink. No attention can be paid to penciled letters.
3. Sketches, diagrams, etc., must always be on separate sheets.
4. This department does not answer questions by mail free of charge. The editor will, however, be glad to answer special questions at the rate of 25 cents for each. On questions entailing research work, intricate calculations, patent research work, etc., a special charge will be made. Correspondents will be informed as to such charge.

Kindly oblige us by making your letter as short as possible.

Transformer Queries

(382)—John Watson, Chicago, Ill., wants to know:

Q. 1.—Please give data for the construction of a ¼-kw. transformer for use on a 110-volt, 60-cycle line.

A. 1.—You will need a core made up of sheet iron laminations 1¼ by 3¾ inches built up to a thickness of 1¼ inches. The laminations are stacked in the customary manner by interleaving the joints. The finished core will be 5 inches by 5 inches by 1¼ inches thick, having a window or opening 2½ inches square. The primary winding consists of 530 turns of No. 14 D. C. C. magnet wire. The secondary winding will depend upon the current and voltage required, bearing in mind that to step down the voltage, few turns of a comparatively large wire are required, and to step up the voltage, many turns of a fine wire are required.

Q. 2.—Could I use a core of soft iron wire which was previously wound on a wooden form, instead of the usual built up type, with equal efficiency?

A. 2.—Yes. All that is necessary is to make certain that the cross-section of the iron wire core is large enough, which, for the transformer mentioned in question would require a cross sectional area of 1¼ by 1¼ or 1.56 square inches. Knowing the diameter of the iron wire we can figure the cross section of it in square inches, divide 1.56 by this value and obtain the number of turns of iron wire required. The finished core may be circular in cross section. It is easier, however, to wind the primary and secondary coils first, and thread the core wire through them, as there will be fewer turns in the core than in the coils.

Q. 3.—Since an ammeter is wound with heavy wire and a voltmeter with fine wire, would one wound with a medium size wire indicate the watts?

A. 3.—This apparently would seem to be the case, but we must consider that an ammeter having few turns of a large wire is connected in series with the line, and a voltmeter with many turns of fine wire is connected across the line. Therefore, if we had one with a medium size wire, where would we connect it, in series or across the line? If connected directly to a line having no other devices in the circuit, it would indicate the watts consumed by itself, but not the watts consumed by a motor or other device also connected to the same line. A watt meter is a combination of a voltmeter and ammeter, having a few turns of a large wire connected in series with the line and many turns of fine wire connected across the line, the magnetic field of both coils acting on a common armature attached to a pointer that indicates the watts. The instrument you refer to would not indicate the watts; and it would consume too much energy.

High Voltage Query

(383)—Jack Burke, Seattle, Wash., asks:

Q. 1.—What is the meaning of the term "above ground" and "below ground" when applied to high voltage lines and transformers?

A. 1.—This is clearly explained by means of the illustrations. For example, suppose we connected 333,333 1½-volt dry cells in series so as to obtain 500,000 volts, and also connected the negative terminal to the ground. The negative side would then be at zero or ground potential. The positive side, however, would be 500,000 volts "above ground," and would have to be insulated for 500,000 volts. This is shown in Figure 1, in which the positive side is insulated from ground by means of the petticoat insulator. Now suppose we connect 333,333 more dry cells in series and grounded the positive side. This is also illustrated in Figure 1. In this case the negative side is 500,000 volts "below ground," and also has to be insulated with the 500,000-volt high voltage insulator. Consequently in Figure 1 there is a difference of potential of 1,000,000 volts between the two ends, with the center grounded, the positive end being 500,000 volts "above ground" and the negative side 500,000 volts "below ground." It is comparatively easy to insulate a line or transformer winding for 500,000 volts, but when the line or winding is 1,000,000 volts above or below ground it is a difficult matter. This is shown at Figure 2, which shows 666,666 cells connected in series with the negative side grounded. As the positive side is 1,000,000 volts above ground, it must be insulated for 1,000,000 volts, which requires an insulator having twice the breakdown voltage of the 500,000-volt one, and hence requires about four times the volume or amount of insulating material. The difficulty of insulating a 1,000,000-volt transformer with one side grounded is therefore much greater than that of insulating one with the center of its winding grounded. Of course, the dry cell illustrations given herewith are only an analogy, and should not be considered practical.

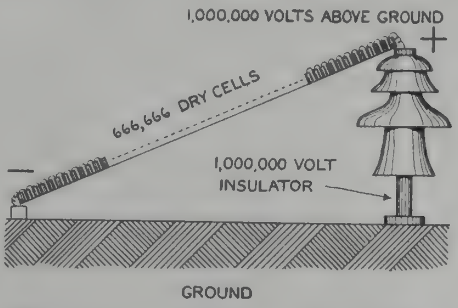
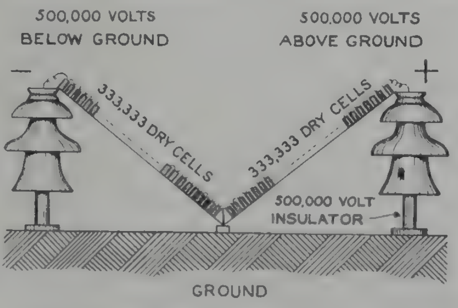


Illustration of the action of high-voltage insulators and of the requirements for making them effectual.



Further illustration of the same subject, this time assuming two points on the circuit, one above and one below the ground potential.

10 KW. Transformer on 110 V. Line

(384)—Virgil Wright, Wilmington, O., wants to know:

Q. 1.—Can I use a 1-kw. transformer on the 110-volt lighting circuit to operate a Tesla coil?

A. 1.—You may use the 1-kw. transformer on the lighting circuit, but its use is not recommended as usually this circuit is only designed to supply 660 watts. It would be necessary to employ at least 15-ampere fuses in the mains, and in this case if a flatiron or electric toaster were connected in the circuit in another part of the building the fuses would be blown when the 1-kw. transformer circuit was closed.

Q. 2.—Would the lights flicker very much?

A. 2.—Yes. The brilliancy of the lamps will decrease every time the circuit is closed. In some cases the lights have been known to flicker in several houses along the street where the 1-kw. transformer was operated.

Field Exciters

(385)—George Smith, Havana, Cuba, asks:

Q. 1.—If an alternating current generator produced only A. C., how can it excite its field, which, as I understand it, has to be excited by a direct current?

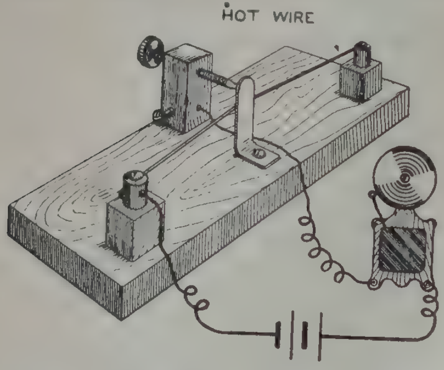
A. 1.—The field of an A. C. generator may be excited several ways. In many large machines a separate D. C. generator is belted or direct-connected to the shaft of the alternator, and this dynamo supplies the necessary field excitation. Where a large number of alternators are operated in one power station, separate exciters are usually employed. These supply current for a number of alternators. In case of failure or damage to the exciters that would necessitate the closing down of the whole plant, emergency circuits are provided for, which supply direct current from another source, such as from storage batteries.

Hot Wire Fire Alarm

(386)—Bud Williams, Detroit, Mich., asks:

Q. 1.—Please give me details for making a practical temperature-actuated device that will close a circuit and sound an alarm when the temperature of a room exceeds a predetermined value, such as would be the case if the building caught fire.

A. 1.—With the aid of the illustration you should have little difficulty in constructing the thermostat shown. This utilizes the principle employed in hot wire ammeters. A No. 30 German silver or nichrome wire is stretched between two fixed points, one of the points serving as a binding post for one of the electric connections. A spring strip pressing against the center of the wire holds it under tension, so that as the wire expands, due to a rise in temperature, the spring takes up the slack and moves slightly, closing the circuit and ringing the alarm.



Interesting example of a thermostat alarm, operated by a thin resistance wire, ringing an alarm bell when the current is too strong.

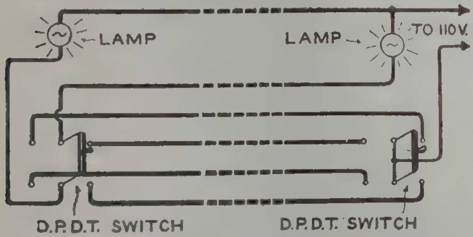
A wire six inches long will be suitable for ordinary purposes. By means of the adjustable contact screw it can be calibrated to sound the alarm at any predetermined temperature. Another feature of advantage about this device is that when the alarm is once sounded it will continue ringing until stopped by hand. This is due to the fact that the battery current passes through the hot wire when the circuit is closed. This current prevents the wire from cooling and opening the circuit.

Odd Lighting Circuit

(387)—H. W. Kelly, Richmond, Ind., asks:

Q. 1.—Will you please tell me how I can arrange two lights, one in each room, and a switch in each room, so that when I turn on either switch one light will be put out and the other lighted? I would want them connected to a 110-volt circuit.

A. 1.—As shown in the diagram, this circuit requires complicated connections, there being six wires running from one room to the other. A double pole and double throw knife switch is used in each room, but if either switch is left open both lights will be out. If both switches are closed, either one or the other light will be lit, depending upon the position into which either switch is thrown.



Somewhat complicated connection for operating two lamps in different rooms, so that by throwing a switch in either room one lamp only will be lighted and the other will be extinguished.

Uses for Burned Out Tubes

(388)—W. T. Swingle, Hastings, Neb., asks:

Q. 1.—Is there any use for burned out vacuum tubes?

A. 1.—A burned out vacuum tube is practically useless. It costs nearly as much to repair as a new one would cost and the repaired tube will never be as efficient as the original one. For some purposes the base of the tube may be found useful. If the glass bulb is removed and a wooden handle inserted in its place it may be used as a connection plug, a vacuum tube socket acting as the receptacle. Four wires passing through a hole in the handle soldered to the four prongs will serve as the connection leads. This would then be a handy device for testing the wiring in a radio set, as it could be inserted in each socket before the tubes are put in, and a voltmeter connected to the leads would indicate the voltages applied to the socket, so that there would be less danger of burning out tubes. Perhaps our readers can tell us other uses for these tubes. We know of no concerns who purchase them.

Tungar Transformer

(389)—Claude Schaffner, New Haven, Conn., writes:

Q. 1.—I have a 1917 Hupmobile starter armature. By applying extra windings can I convert it into a transformer to operate a two ampere Tungar bulb for recharging a 120 ampere-hour A battery?

A. 1.—We would not advise you to attempt to make a transformer out of the starter armature as it would require a good deal of experimenting before satisfactory results would be obtained. It would be much easier and more satisfactory to build up a core as described in the March (1923) issue and wind it with smaller sizes of wire, using 197 turns of No. 16, six turns of No. 8, and 73 turns of No. 12.

Electric Thriller

(390)—Leon Breault, Woonsocket, R. I., asks:

Q. 1.—I have an electric thriller used for giving shocks to a group of people holding hands. Can I rewind the armature so as to light a 1.6-volt flashlight bulb?

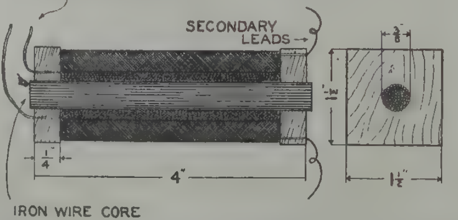
A. 1.—The thriller now has many turns of fine wire on its armature. You should remove this, carefully noting how it is connected, and then proceed to rewind it with much larger wire, about No. 22 B. & S. gauge. Of course the voltage generated will depend upon the speed the machine is run at, care should be taken not to run it too fast or there will be danger of burning out the flashlight bulb.

Medical Coil

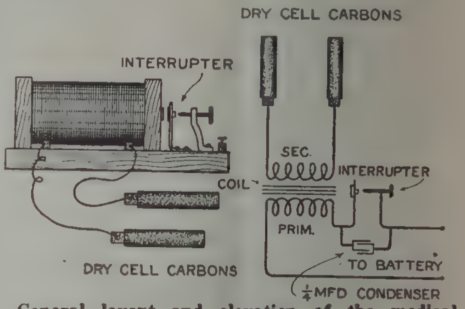
(391)—Isadore Litvak, Brooklyn, N. Y., asks:

Q. 1.—Please tell me how to make a medical coil.

A. 1.—On an iron wire core three-eighths inch in diameter and four inches long, mount two square wooden spool-ends as shown. Wrap two or three layers of paper around the core and then wind with four layers of No. 24 B. & S. D. C. C. magnet wire. The two ends are brought out through the wooden ends and connected to the battery and interrupter as shown in the diagram. Wrap four layers of paper over the primary coil and then fill the spool full of No. 36 B. & S. silk-covered wire. The two ends of this coil connect to two battery carbons or other suitable electrodes which may be grasped by the hands when taking the treatment. Any suitable vibrator or interrupter may be employed, such as one taken from a small buzzer. A one-quarter mfd. condenser should be purchased and connected across the contacts as shown. The coil is operated on two or three dry cells. The intensity of the "shock" may be adjusted by means of a rheostat in the battery circuit.



Section of a medical induction coil for giving electric treatment to invalids.



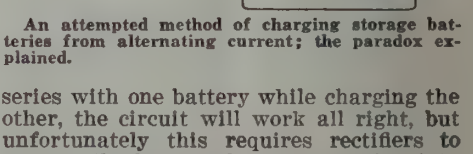
General layout and elevation of the medical coil just described.

Charging Batteries on A. C.

(392)—Jack Everest, Pittsburgh, Pa., asks:

Q. 1.—Is it possible to charge storage batteries on alternating current by using the circuit shown in the accompanying diagram? In this diagram the two storage batteries are connected so as to oppose each other, and the two free or negative terminals are connected to a 6-volt A. C. supply. Assuming the batteries are half charged, the first half cycle will charge one battery, which will take half the current from the other battery and the other half from the line. During the next half cycle, this battery discharges into the other, which also takes half the current from this battery and half from the line. It would seem then that each battery is charged by the other battery and the line and receives more energy during charge than it gives up. Would not both batteries finally become charged?

A. 1.—Although the A. C. line supplies current to both batteries, as much current flows through the batteries during charge as during discharge, and as it is the potential producing current that causes the chemical changes to take place inside of the cells they would not become charged. The current circulating through them would merely heat them. If the A. C. line were connected in parallel rather than in series with one battery while charging the other, the circuit will work all right, but unfortunately this requires rectifiers to prevent the battery from discharging into the line during the other half cycle.



An attempted method of charging storage batteries from alternating current; the paradox explained.

Aquarium

(393)—John McLetchie, Melrose, Mass., asks:

Q. 1.—I have a large aquarium and would like to put a few electric lights inside of it. Naturally they will have to be under water. Kindly let me know if this is possible and how to do it.

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Omission

On the first page of our last issue we published views of animal automata. We omitted to state that these are manufactured in New York City, and that we are indebted to Messrs. Messmore and Damon of this city for the photographs.

How and Why?

(*Continued from page 272*)

A. 1.—We would suggest that you dip the lamp socket and connections into hot paraffin several times so as to form a thick coating of wax. All but the large part of the glass globe should be coated with the wax, and as the lamps are under water they will not become warm enough to melt the wax.

Small Transformer

(394)—Joseph Ruz, Youngstown, Ohio, writes:

Q. 1.—I have a small step-down transformer with a core made up of steel laminations of the size shown in the illustration. The primary coil consists of 680 turns of No. 30 D. C. C. wire and the secondary is wound with No. 24 gauge wire. I can operate a small toy motor and an automobile horn but the transformer becomes very hot.

Will you please tell me what is the matter with it?

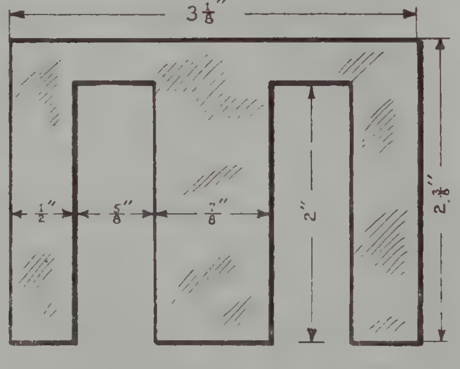


Diagram with dimensions of a lamination of a transformer, to which the answer refers.

A. 1.—The reason your transformer becomes hot is because the wire is too small to carry the current. No. 30 wire will safely carry .08 amperes, which multiplied by 110 gives the watts, or nearly nine watts. If you draw more than nine watts from the instrument it becomes hot. You cannot use larger wire because there is not room for it on the core, so the best thing is to make an entirely new transformer, many of which have been described in other issues of this magazine.

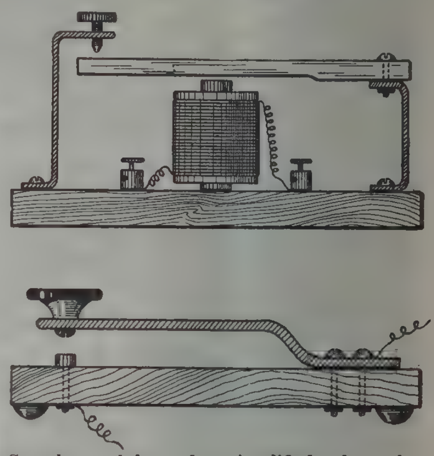
Q. 2.—Can I use a transformer to start an automobile starter, operating the starter on A. C., of course?

A. 2.—Starter motors are usually series wound, and a series wound motor may be operated on alternating current as well as on direct current. However, it may be necessary to install an A. C. motor in the car in place of the D. C. one. Should you build a transformer for this purpose, it should have a 6-volt secondary capable of giving an intermittent current of at least 150 amperes, which is the average consumed by a starter motor. We do not advise you to do this, however, as it can not be used on the house lighting circuit on account of blowing fuses, and a special power circuit would have to be installed for its use.

One Wire Telegraph

(395)—Don Ault, Piches, Okla., asks:

Please show the connections of a telegraph that can be used between two houses with only one wire between.



Sounder and key of a simplified telegraph apparatus, one quite sufficient for practice and for learning the code.

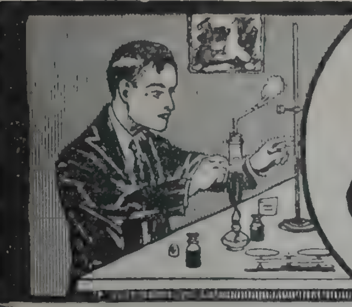
A. 1.—The illustrations show such a telegraph system. Only one wire is required between the two stations because the ground is used for the return. At each station is a battery of two dry cells, one telegraph key made from a piece of spring brass as shown, and one telegraph sounder. The sounder is made with an electro-magnet, such as are used in electric doorbells. A spike driven in the wooden base may be used for the magnet if it is wound with several layers of insulated magnet wire. A bar of iron is attached to a piece of spring brass screwed to the base, the iron acting as the armature that gives out the audible clicks when attracted by and drawn away from the magnet. An adjustable stop is placed above the armature as shown. The back stroke is produced here. A switch is connected across the key; this switch is closed while receiving a message from the other station, and opened while sending with the key. The waterpipe, or any other pipe or plate that enters the ground may be used for a ground connection.

Artesian Wells Sources of Electrical Energy

THE demand for electrical energy for light and power is leading to the development of power-sources hitherto not thought of as available for power purposes and artesian wells and geysers are among the latest recruits to be put to work.

In northern Florida there are numerous artesian wells, deriving their upward pressure from their higher source in the Appalachian Mountains. The weight of water, whether it flows down, as ordinarily, or upward, as in the case of an artesian well, is a source of hydro-electric power. Small turbines, varying from 150 to 2,000 watts, are mounted directly over the wells and are producing electrical energy on a number of Florida farms. A storage battery is used with these installations, and is continuously charged by the generator. Since an overflow is necessary to keep an artesian well in good condition, the farmer not only has his electrical power, but his irrigation water as well.

From the opposite end of the country, California, is announced the projected use of live steam from a series of geysers to operate electrical generating machinery. One well has been bored and capped, and it is estimated that the steam therefrom will generate 2,000 horsepower of electrical energy. The use of steam from



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(Names and addresses on request)

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the earth for this purpose has already been developed in Italy, where volcanic steam is producing 10,000 horsepower in the neighborhood of Pisa.

Sam Graves' Gravity Nullifier

(Continued from page 241)

the handiest weight carriers we could get and the sand was lying all around us. Sam is making an automatic speed governor; that's what he's gone to Chicago for—to get some parts. Say, let me tell you how he built that supporting platform way up there. The man who helped will tell the same story.

"You see, there was no way to get even a pack mule up there. The men cut out a trail and scrambled up with what tools they needed, but those beams weigh nearly two tons apiece. The men just rigged a wooden derrick with a light hoisting rope and then Sam nullified those beams and one man pulled them up as easily as if they had been made of cork. It was the same with the big wheels and the cables! Savvy?"

"I savvy, all right!" murmured the President.

On the short run back to the bungalow Lundholm asked: "Mrs. Graves, do those men who helped, and that mechanic who's with us, know anything about the nullifier?"

"No more than you do, Mr. Lundholm. No one but Sam and myself has ever had one little look into that box."

"That's good!" he muttered. Then after a long pause: "As soon as your husband gets back, telephone me, if you please, and we'll arrange for a conference. This matter will, I think, have to be very carefully handled."

"All right, Mr. Lundholm. We'll be ready."

"And your husband has applied for a patent, of course? Perhaps you have a copy of the specifications and drawings. If so, we'd like to have a chance to look them over. It would save time, of course."

"He hasn't applied for a patent, sir. He made out the specifications and drawings, but I persuaded him not to go so far yet. I think I showed him that it was far wiser to keep the process secret—at present, at least."

"You! You advised him that!" The President displayed almost as much amazement as when he lifted his own car with one hand. Then a grim smile came over his face. "I thought a woman—most women—never absolutely kept a secret."

She tossed her little head and pouted. "Perhaps that is so, Mr. Lundholm, but I've had some office training with men—real men, the Cartwright Cattle Company—and I've learned what it means, sometimes, to keep a secret."

The puzzled look came back into his eyes and he lifted his hat courteously and drove away with his engineer, while Edna sought out a box of chocolates, snuggled into the hammock again and opened a well-worn notebook, murmuring joyfully: "Let us see what I've got about Mr. George Lundholm."

She fingered over the leaves until she found the clipping she sought. It was from a Denver daily and read:

"In a recent interview with George M. Lundholm, the millionaire president of several great industries in the intermountain region, he said: 'Never since I started on my career have I been in anything in which I had not secured complete control. When I cannot secure that I let the whole matter severely alone!'"

She laughed roguishly. "That means that he won't play unless he has a perfectly good hand! And Bret Harte says: 'Life ain't th' holdin' of a good hand, but th' playin' of a poor hand well.' M-mp! I think that Sammy and I are going to see some life, pronto!"

A week after she was telling her husband of the President's visit. She finished with: "So you see, Samivel, that Lundholm won't come in unless he has full control—he thinks."

"What of that?" retorted Sam. "If he buys outright let him have all the control he wants. That's his business! Sell him for a million dollars if he'll give it. If not, make it a quarter million or a half."

"A million dollars!" she gasped. "Only one little million for a new power of world-wide application?"

"It's all we want, Edna. I've got other things on my mind that'll bring in more."

"Just like an inventor!" she laughed, a little bitterly. "No business instincts at all. Almost unlimited wealth in your grasp and you're sidetracking yourself to make other inventions!"

"Well, my girl, you can't get even that million without giving control with it. Big capital won't come in any other way."

Her eyes flashed and she said eagerly: "You say I can't get it! Do you mean that you'll leave it to me?"

"Sure do! You can play the hand if you like. I'm not afraid of your losing all, and I don't want to be bothered with it!"

"That goes, Sammy! Just don't trump my aces and I'll see that the pot builds up to a respectable size. I'm not playing on a little million dollar limit. Watch me!"

She presented herself a few days later at President Lundholm's office and was received courteously, but with an evident expression of doubt and surprise.

"Hasn't Mr. Graves returned yet?" he asked.

"Oh, yes! But he's very busy on that automatic governor, Mr. Lundholm, and he doesn't want to waste time on business details, he said, so he sent me."

Instantly there came a suspicion to the President's mind and a fierce scowl swept over his face as he thought it possible that the "damned fool sent his wife here to vamp me; to squeeze a few thousand more out of me with pretty smiles and childish talk. Hell!"

Then, flashing as quickly as a movie picture change, came another thought: "It's their ignorance of any gleam of the real value of the thing. The fool's sending her into town to sell it—to sell this prodigious value—just the same as he sends her in to buy a pound of tea and box of crackers. They're pikers and acting like pikers and they're surely my meat!"

"I hope you're not disappointed, Mr. Lundholm," she murmured as she noted the black cloud over him. "Sam is an inventor. He knows and cares little for business. He always leaves such things to me. I am sure that I can tell you plainly what we propose."

He felt jubilant. This was going to be much easier than he had expected. "All right, Mrs. Graves. I suppose you've brought the drawings and specifications with you?"

She shook her head and smiled. "No, sir. We decided that we would not reveal the secret until a real company was formed and we were paid what we think right."

"Good Lord! Mrs. Graves. Can it be possible that you expect me to waste my time in organizing a company and looking up capital for something I know absolutely nothing about?"

"You've seen what it will do, Mr. Lundholm."

"Capital hasn't seen it!" he retorted, grimly. "What sort of fool would I look to ask men to put up perhaps two or three hundred thousand to exploit some machine that's locked up in a box and which I don't know is metal or er—legerdemain? Ridiculous! We may as well end this interview right now, Mrs. Graves. I am a pretty busy man."

She smiled bewitchingly. "You're also a man of big reputation, Mr. Lundholm, and too good a sport to throw up your hand without seeing a little further into the game!"

Perhaps she hit him right. Anyway, a curious twinkle came into his eyes. "What's the ante, Mrs. Graves?"

"Not even a white chip, sir, until you see those papers and drawings. Here's our proposition. You form a company with ten million dollars capital and pay us six millions in stock for the patents. When that company is incorporated and the stock paid in we'll give you all drawings and specifications; apply for the patent and assign it to you."

He gasped as he slumped back in his chair, and the term "Pikers" went before his eyes in circles. Presently he sneered: "And suppose that patent is never allowed?"

"I've thought of that, please. You can put our six million dollars of stock in trust somewhere to be delivered to us when that patent is allowed—not before. Isn't that fair?"

He scowled again without answering the question. "The sum you mention is absurd; quite out of the question. Make it a million capitalization—you take forty per cent for the patents, and I'll talk to you."

"Oh, dear no, sir! If it was only you we were to deal with we might do something like that. But with a company we never know who are friends and who are—are schemers. We must retain control!"

Beneath the smiles, the roguish curves of the lips, the almost girlish pleading in the tones, he saw a determination in the eyes and chin which surprised him. He grimly smiled as he remembered, "And I thought they were pikers." Then:

"Of course your figure is absurd! You're estimating what the invention will do far above its merits. Now look! What special saving would there be with your—er—barrel power plant over a hydraulic plant? Water costs nothing; the entire cost is in the harnessing, and you've got to spend about as much to harness your gravity nullifier."

She gasped a little at that thought, and he followed up his point:

"You spoke the other day of its revolutionizing transportation. How would it? You've got to transport goods, even if a carload doesn't weigh a pound, and it costs nearly as much to run empties as to run loaded cars. The tracks, rolling stock and personnel all have to be there. Besides, how would you keep trains on the tracks if they had no weight?

"It's the same with vessels. If a hold is full of freight that has no weight, the ship would have to take in ballast, and if you nullify the gravitation of one you'll do it with all. No vessels would ever untie from a wharf with practically empty bottoms. How would you move stuff? You'd destroy all transportation instead of helping it!"

But she had recovered herself now and smiled frankly. "Those are good talking points, Mr. Lundholm, but I have some good ones, too! How about steam power with its tremendous cost of great engines and enormous consumption of coal and oil? How about using nullifiers on great construction operations: building skyscrapers, great dams and bridges? How about getting minerals and coal up two

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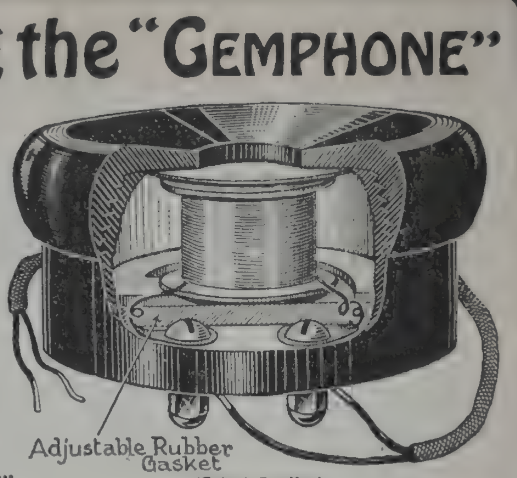

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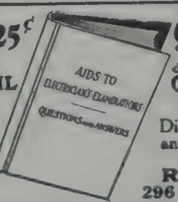

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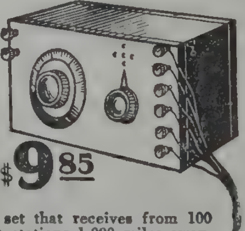

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or three thousand foot shafts? Besides, there may be development of control which will make it fully as useful in transportation."

"You haven't shown any indication of it yet, Mrs. Graves."

"We surely have! Don't we take the gravity out of just what barrels we choose to, up there at the canyon, and leave those we choose to normal?"

"But how?"

"I didn't call your attention to that, sir. Those barrels are connected in groups of twenty, and we can turn the nullifier current into any one of those groups without affecting the others."

"How about the cables, Mrs. Graves; don't they carry the current?"

"They're insulated from it. You noticed that every barrel has an iron tube running clear through it, the ends projecting about a foot from each end. Those tubes hold the barrels to the cables, but where they are fastened to the cables they are in solid rubber insulations."

"I see," he murmured. "Of course other improvements may be made. And, as you say, the thing surely has some value. But——"

There he paused and his brow was heavily corrugated and his eyes half closed. "I tell you what I'll do. I'd rather keep this in private control for the present. I have two propositions. I'll capitalize an ample factory to manufacture the nullifiers and develop a trade for them and give you half the profits. Or I'll give you two and a half millions outright for the patents when they are secured."

She scarcely pondered for a moment. "I think we'd rather take the cash, if it was five millions instead of two and a half. I really believe that your offer of half profits would pay better, but I suppose I'm a little weeny bit like Mr. Edison. Did you ever hear what he once said? I'll show you."

She took her little notebook from her bag, turned to a clipping and read: "Thomas Edison once said: 'I always play my blue chips first. I think of the biggest thing that could be done and try to do that. Many men take twenty years to get where they should have started the first day.'

"That's the way I feel, Mr. Lundholm. We might get two or three times five millions in twenty years, but we're going to play our blue chips first. Savvy?"

Again his eyes half closed and the deep corrugations wrinkled his forehead as he muttered to himself: "And this is the woman I thought a piker, or a little married flapper trying to play business."

He glanced at her keenly. The shrewd, keen, cold eyes, the thin, tightly compressed lips, the obtrusive chin of the business woman were not there in the slightest degree. Priding himself, as he always had, in his ability to quickly estimate any man, he found himself utterly bewildered by this attractive little woman in her sport skirt, her brushed wool sweater and jaunty hat pressed down on curly head so firmly that only the twinkling innocent eyes peeped at him from under the narrow brim.

Presently he grunted: "I guess it will have to be as you say." He pressed a button, and when his stenographer appeared, said:

"Jim, take down an agreement; two copies!"

He dictated, and when the typewritten copies were ready, handed one to Edna, who read it carefully. She handed it back.

"The last clause, Mr. Lundholm, reads: 'Any improvements or additions made at any time by the said Samuel Graves shall become the property of the said George M. Lundholm without cost to him.'

"There should be added to that, sir, that the cost of experimenting and making such improvements will be paid by you."

He laughed grimly. "'To the last pound of flesh,' eh? Make that change, Jim!"

Then, with a very earnest expression, he added: "If you had accepted my first offer I should have suggested that you become an active partner in the business—the business manager, in fact. You have just the qualifications for this particular thing. I don't mind telling you now that I had decided before to limit my offer to a million or perhaps a million and a half. And you've forced me to raise my ante to five millions!"

"Yes," she laughed, "but don't forget that you take the whole pot, Mr. Lundholm!"

"Ball Lightning"—An Explanation

By E. Kilburn Scott, M.Inst.E.E.

FROM time to time one sees in the daily press, and occasionally in scientific journals, circumstantial accounts by people who say they have seen a ball of fire, or globular lightning, as it is called. Occasionally the particulars are given in considerable detail by observers who have scientific knowledge, and also by others who are not given to imagining or exaggerating what they see. It seems to me, therefore, that the attitude of pooh-poohing the matter and saying that it is merely an optical illusion is not justified; the accumulation of evidence is much too great for that.

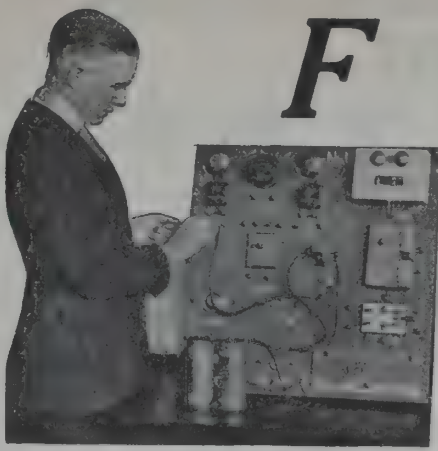
After thinking about the phenomenon a good deal I have come to the conclusion that it can be explained in quite a simple rational way that fits in with well-known chemical and electrical facts. I believe that the ball is concentrated or possibly liquid nitric oxide gas, which has been made by a relatively short flash from a low-lying cloud to earth. Certainly all the observations fit in well with the formation and action of such gas.

We know that when air is passed through an electric arc flame in a large electric furnace, the nitrogen and oxygen combine to make nitric oxide gas, which, as it cools down, begins to take up more oxygen and form nitrogen dioxide. The process is quite well known to electrochemists, and in Norway, and elsewhere, a plant has been running for many years which aggregates over half a million horsepower and makes nitrates from the air in that way.

We also know that when lightning strikes through the air it makes nitric oxide. That is one of nature's ways of fertilizing the soil, and it has been estimated that 100 million tons of nitrogen fixed by lightning flashes fall annually on the earth's surface.

The energy suddenly released by a flash is enormous, and the pressure has to be millions of volts so as to tear a way or a hole through the air dielectric. I expect that momentarily a very high pressure is set up, immediately followed by a reaction which gives a sudden chilling effect. If that be so, then the conditions are extremely favorable to the production of a large amount of nitric oxide gas in a very concentrated and probably liquid form.

Lightning is of two kinds, namely, flashes between a cloud and earth, and flashes between clouds. When the first occurs the cloud has first to come relatively close to the ground, and that is why there is darkness just before a storm, also the most violent flashes occur before the rain has had time to lower the tension by discharging it piecemeal by raindrops.



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Assuming that highly concentrated or liquid nitric oxide gas is rolled up, as it were, into a ball by such a lightning flash, then owing to its density it would gravitate slowly downward in exactly the way that observers say they have seen. While doing so, the outer layer of the gas will be gradually oxidizing to nitrogen dioxide, and this will dissipate in the air, and if the length of travel through the air is long enough it will all disappear in that way. Occasionally, however, the ball of gas starts to fall from a point so near the earth that some of it is still in the form of a ball of concentrated nitric oxide when it arrives at earth level.—*Elec. Rev.*

A Strange Lightning Stroke

By B. E. Thompson

My employer was asleep upon an iron bed during an electrical storm. About four feet from the foot of the bed there was a telephone upon the wall.

A flash of lightning ran in on the wire, jumped from the telephone to the bed, and tore the shoe from the right foot of the sleeper, hurling it through a space of about seven feet to the outer side of the room.

The shoe is still in his possession, so badly mutilated as to resemble a rat's nest, although my employer was not injured in the least.

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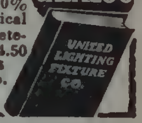
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Edison Medal Awarded to Prof. Millikan

THE Edison Medal for especially meritorious achievement in the field of electricity was presented recently to Professor Robert Andrews Millikan of the California Institute of Technology. This award is the highest which the electrical engineers of America can pay to anyone.

The presentation was made at the Pacific Coast Convention of the American Institute of Electrical Engineers at Del Monte, California, by Dr. F. B. Jewett, talking from New York over the transcontinental line of the Bell System. Dr. Jewett, vice-president of the Western Electric Company, was president of the American Institute of Electrical Engineers at the time the award was voted. A public address system installed in the convention hall made his words audible to everyone present.

At midnight by New York time Dr. Jewett began to speak into a microphone at the New York end of the long distance line. At nine o'clock by Pacific Coast time the convention at Del Monte began to hear what he said. Dr. Jewett said: "Probably the best known and most noteworthy of Millikan's works are his so-called 'Oil-drop' experiments, which were undertaken for the purpose of making precise measurements of 'e,' that is, of the fundamental electrical quantity. These experiments proved conclusively that all electrons are alike and the results obtained by Millikan have been of inestimable value in the calculation of physical constants. In a word, the results which he obtained were revolutionary in character and eliminated almost completely the necessity for surmise and hypothesis in the interpretation of many phenomena and experiments.

"Second only to the oil drop experiments is Millikan's work on photo-electric effect and his measurement of the so-called 'h' constant. This is a universal constant of fundamental importance in the structure of the atom and in the relations between matter and radiation: its meaning is doubtless not yet fully clear. By identifying and measuring this constant in his experiments on photo-electric phenomena, Millikan made a very important contribution to modern physics.

"More recently Millikan's work has tended toward a definite bridging of the gap between light and X-ray phenomena. By this work he has pushed the ultra-violet spectrum down about two octaves, or nearly, if not quite, to the long wave length X-rays.

"All three of the foregoing monumental pieces of work are, I think, typical of Millikan's place in the scientific world."

Dr. Jewett characterized Professor Millikan as being "in the first rank of physicists as a great consolidator and experimenter." He went on to say:

"Reference should also be made to the Physical Review Papers of 1923 on the coefficient of slip, the reflection of molecules, and the complete law of fall of a particle through a gas at all densities, definitely settling one of the historic problems of the kinetic theory which has been incompletely treated both theoretically and experimentally by scores of papers during the past twenty-five years. These 1923 papers establish both theoretically and experimentally the complete solution of the law of motion of particles through a gas, to which Sir George Stokes gave a very important limited solution known as Stokes' law some fifty years ago.

"Among minor contributions may be named the establishment of the independence of the photo-electric effect upon temperature, the experimental proof of the

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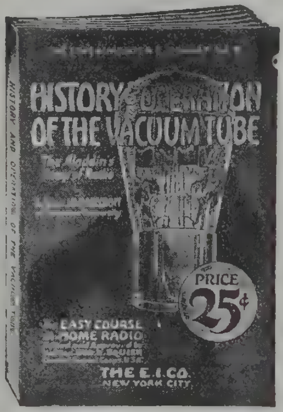
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Major General Geo. O. Squier, Chief of the Signal Corps, U. S. A.

This book serves an interesting study of the fundamental principles, historical evolution, and practical application of the vacuum tube as used in radio apparatus of every description. Since the vacuum tube is one of the most important parts in the modern radio set, and has been largely responsible for making present-day radio entertainment possible, this book has been entirely devoted to the subject of that one particular instrument. It is written in simple everyday language with all technical terms thoroughly explained so as to make matters easily understood by everyone.

The book contains chapters on the phenomena of vacuum tubes in general; the operation of vacuum tubes as detectors and amplifiers; and the junction of the vacuum tube used in various transmitting and receiving circuits, etc., etc.

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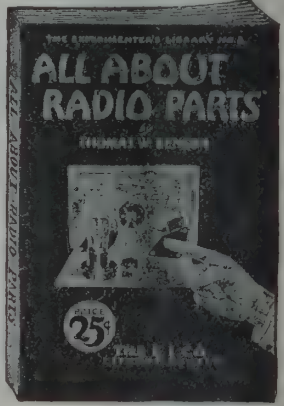

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This book gives an extensive description of the various parts used in all types of receivers, especially explaining the features of certain apparatus and circuits. It also describes why the different parts are used and how they operate. There has been nothing overlooked.

To begin with, the book tells how radio waves are collected by means of an aerial, giving details of construction of different types and their advantages. Then detection is explained and various types of crystal and vacuum tube detectors described. Amplification, including regeneration, radio and audio frequency, is simply told.

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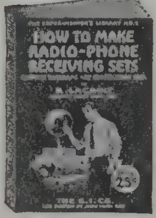

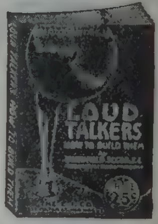

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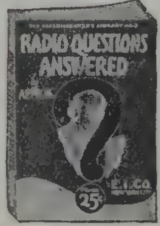

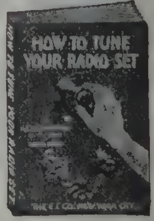

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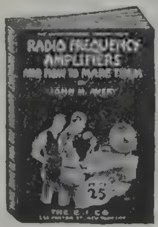

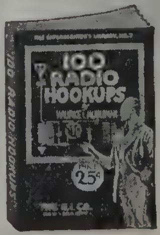

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fact that a light wave may impart an energy to a free electron of the metal, the relation between the contact potential of a metal and the photo-electric work function, the determination of the law of Brownian movements in gases, the conditions for the detachment of two electrons from a single atom by the impact of an alpha or a beta particle against it; the non-existence of an intense penetrating radiation in the upper air, the extraction of electrons from metals by intense applied fields.

"All of Millikan's important contributions to experimental physics have been in the region which is particularly important to electrical engineers, and the results which he has obtained have opened for us vast new areas for exploration and advance which we can make with the assurance that our line of communication is based on a substantial bulwark of established fact."

Dr. Jewett referred also to Professor Millikan's work during the war and in the formation of the National Research Council, and to his influence as a producer of men. "In the past two decades," he said, "Millikan has done more to influence young men in the direction of scientific research along lines of clear thinking and with a high goal of prospective attainment, than anyone else in America."

Educators Urge World Metric Units

WORLD-WIDE adoption of the metric units of weights and measures was strongly urged at the World Conference on Education, recently held in San Francisco. The metric resolution, passed for the conference, was discussed in the group session on Greater Unification in Science, the committee in charge being Y. Ishimura (for Asia), Dr. Maria de Maetzu (for Europe) and Percy E. Rowell, Chairman (for America).

In certifying the metric action, Augustus O. Thomas, President of the world conference, gives hearty endorsement of the proposal to place the United States of America on the decimal metric basis.

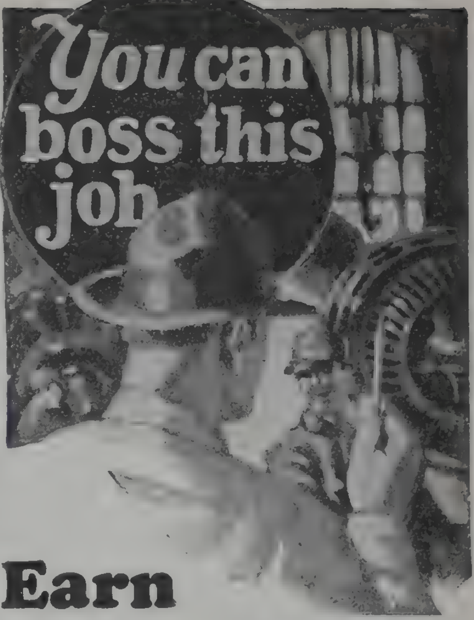
Educational leaders, it is declared, are uniting with influential manufacturers, traders, agriculturists, household economists and other powerful groups to secure passage of the metric standards bill which will be introduced in the new session of Congress which met in December. Extensive Congressional hearings have already been held on the metric issue, more than 100,000 voters have petitioned the national legislators to take affirmative action, and metric advocates express confidence that it will not be longer delayed.

The resolution passed at the World Educational Conference in San Francisco is expected to speed the world-wide advance to complete unification of standards of weight and measure. The United States of America is the only civilized nation, except the British, which has not yet adopted the metric system.

Electrical units as used in this country are purely metric, except for one or two exceptions, such as the electrical horsepower. But omitting such hybrid units electricity, like chemistry, is on a metric basis. All advanced thinkers, as they are sometimes called, advocate the introduction of the metric system into daily life units.

Ultra-Violet Rays

THAT ultra-violet rays can cure rickets, a disease of childhood characterized by softening of the bones, was asserted on November 19th before the Academy of Sciences by Professor Richet on behalf of his colleague Professor Laine. The latter, who experimented upon sixty rickety children, states that the patients improve rapidly under this treatment.—*Daily Mail.*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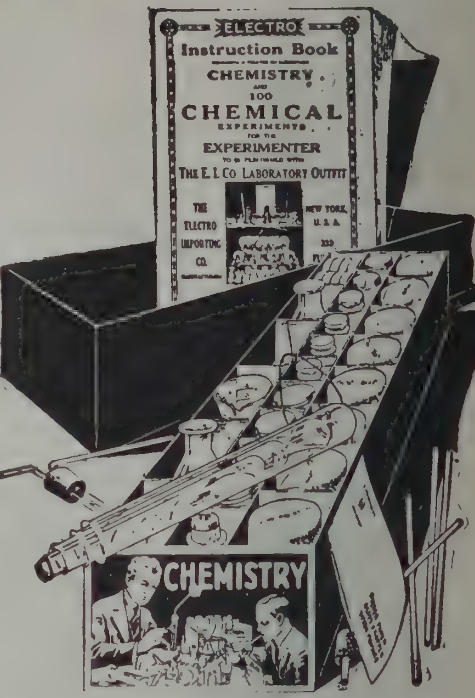

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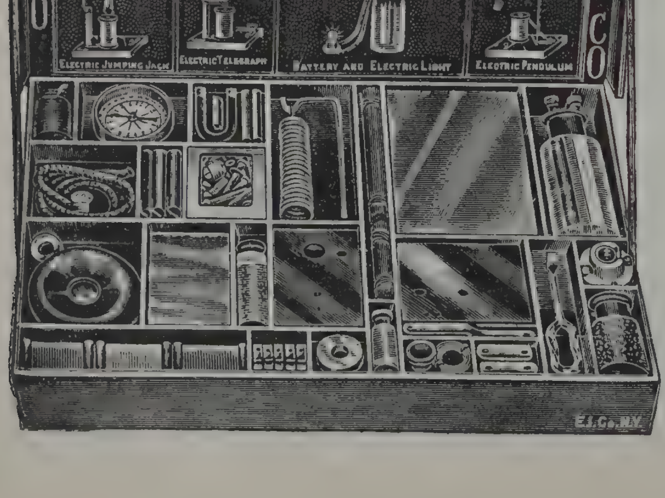

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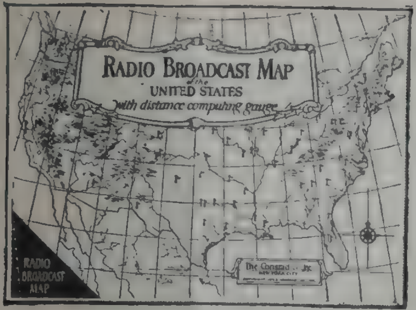

The Consrad Radio Map is different from all other maps in that it is printed on CLOTH and with proper care will last a lifetime.

The Map measures 17x22" and contains a special distance computing gauge of our own design which enables one to find any broad-casting station at a moment's glance.

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The broad-casting stations are contained on a separate sheet which can be fastened to the map by ordinary paper fasteners. The list is up to date and contains the new wave lengths.

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The S. T. 100 Receiver employing a circuit devised by John Scott-Taggart of London, has proven to be one of the most efficient sets of reflex variety for broad-casting reception.

While only two tubes and a crystal detector are used, the energy amplified of incoming signals is powerful enough to operate any type of loud speaker without additional amplification.

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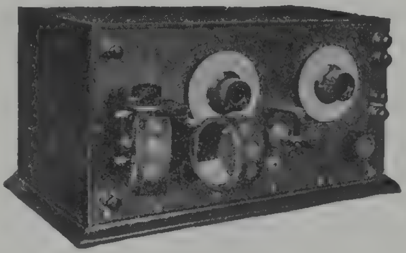

Another important feature is that the set tunes sharply, which is one of the utmost requisites of an ideal receiver.

The packet consists of blue prints for drilling the panel, wiring the apparatus, and a four-page instruction pamphlet giving complete details as to the parts required, tools needed, and even how to tune.

All these are contained in a two color heavy manilla envelope, 9½x12". **50c.**

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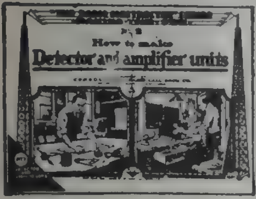

The Consrad "Making Your Own" series consists of plans for the construction of the most popular radio circuits and are gotten up so that anyone can construct a receiving set as easily as a woman can sew the simplest dress. Blue prints are furnished for drilling the panels and wiring the parts and a four-page pamphlet contains complete instruction even as to tuning. Each pattern is contained in a two colored heavy manilla envelope 9½x12" and sells at .... **50c.**

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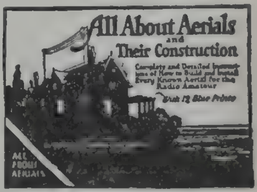
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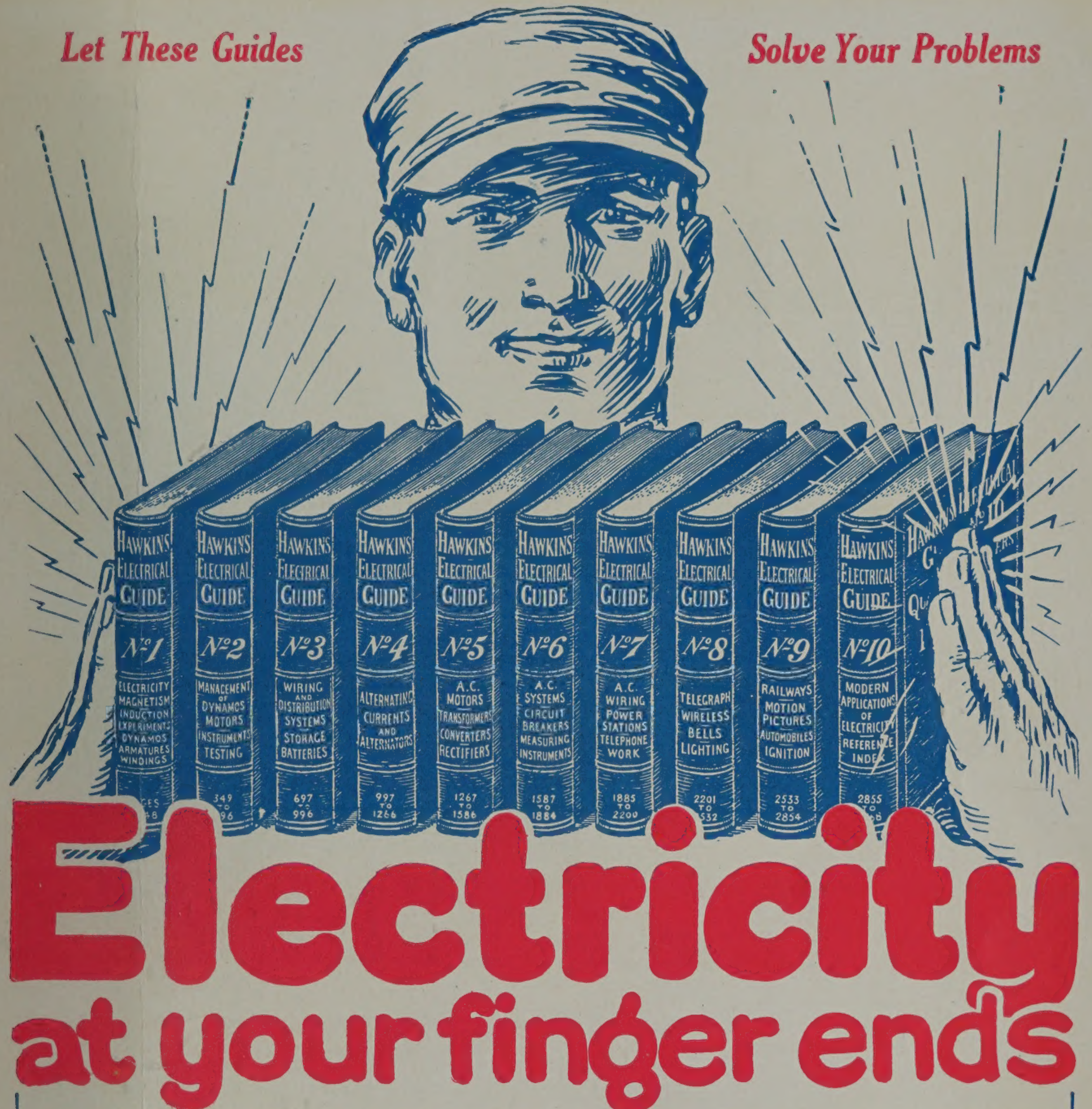
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